THE

ELECTRICAL REVIEW.

VOL. LXV. SEPTEMBER 10, 1909. No. 1,659.

ELECTRICAL REVIEW.

Vol. LXV.] CONTENTS: September 10, 1909. [No. 1,659.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGHEKAY, LONDON," Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

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SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

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FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1909 EDITION

H. ALABASTER, GATEHOUSE & CO.

4, Ludgate Hill, London, E.C.

TRAMWAY POWER TARIFFS.

THERE is at the present time much dissatisfaction on the part of tramway authorities at the prices they are charged for electrical energy. In some places this has culminated in disputes, which are settled either by compromise, as at Brighton and Sunderland, or by arbitration, as at Aberdeen and Peterborough. To understand the situation, it will be well to look at the question from the tramway manager's standpoint, and it will be seen that he has a good general ground for complaint.

It must be remembered that in many towns the tramways are considered to a large extent as an adjunct of the electricity supply undertaking. This was started first, and when the question of the tramways was under consideration the fact that they would prove a good customer to the electricity supply undertaking was not without its influence on the result. Naturally, when the time came for fixing the price to be charged for electrical energy, the Electricity Supply Authority was in a very strong position, and could literally demand its own terms. In cases where both undertakings belonged to the same authority, it was felt that an overcharge to the tramways was not a serious sin, and when the tramways belonged to an outside company or authority, the obtaining of the best possible price was only a good stroke of business. Commercial considerations have, during the past year, forced many tramway undertakings carefully to consider their position. As the lines get older the repairs and maintenance cost more, while the receipts are practically stationary. Wages cannot be reduced, but power costs may. Efforts are made to reduce the consumption of energy per car-mile, with some success, but little difference is made in the power bill unless the price per unit is altered. What wonder then, that the member of a Tramway Committee listens with interest when he hears it argued in the Council Chamber by the Chairman of the Electricity Supply Committee that it is possible to sell electrical energy for power at a profit at rates often less than one-half of those the tramways are called on to pay? He finds out, too, if he likes to inquire, that in some cases, such as Manchester and Bolton, the average price received for all units sold for power to other customers, is less than three-quarters of the price the Tramway Committees are called upon to pay. They ask why, and are referred to their lower load factor and high maximum demand, but they remain unconvinced.

In some towns, such as Glasgow, Leeds, Sheffield and Hull, the Tramway Committees refused to purchase their energy, but insisted on being separate undertakings. Despite the anathemas which were hurled at them as backsliders from the sacred doctrine of concentration, they insisted on building their own power houses. How have they fared, and what is their position to-day?

The answer to this, viewed from the tramway standpoint, is a complete justification for the separate station for large undertakings, and a direct encouragement for the Tramway

Authority to take up the question of revision of prices with a view to obtaining substantial reductions. For instance, we find that in 1908 the 12 tramway undertakings of Cardiff, Dublin, Glasgow, Huddersfield, Hull, Leeds, Leicester, Newcastle, Portsmouth, Potteries, Preston and Sheffield used 104,334,587 units of electrical energy, which they generated at separate stations at an average cost of 0·402d. per unit, or a total of £175,000, the lowest cost being 0·35d. at Glasgow, and the highest 0·73d. at Hull.

During the same period 10 undertakings—Belfast, Birmingham, Bolton, Bradford, Halifax, Liverpool, Manchester, Oldham, Salford and West Ham—used 104,324,142 purchased units, for which they paid to the respective electricity supply authorities £498,900, or an average of 1·147d. per unit; the lowest was 0·70d. at Belfast, and the highest 1·50d. per unit at Oldham. Here we have, for practically the same number of units, a cost of £175,000 in the one case, and nearly £500,000 in the other.

It is true these figures are not directly comparable, but all load-factor and maximum-demand conditions may be taken as similar. The higher figure includes in many cases transforming and feeder losses as well as the interest and sinking-fund charges on the capital cost of the power house, sub-stations where necessary, and feeders. The total kilowatt capacity of the power stations of the above 12 undertakings was less than 48,000 KW., say, 50,000 KW. If an allowance of £55 per KW. is made for the capital outlay on plant, sub-station plant and feeders for this capacity, or, say, £2,750,000 and capital charges for interest and sinking fund of 6 per cent. be allowed, the annual charge would be £165,000, still leaving a financial advantage of about £160,000 in favour of the self-contained systems.

The same general results are found if individual systems of similar size are compared. Take, for instance, Glasgow and Manchester. Glasgow had, in 1908, 178 miles of single track, and used 25,932,890 units of electric energy, which were generated at an average cost of 0·35d. per unit. Manchester had, in 1908, 176¾ miles of single track, and used 29,955,070 units of energy, which were purchased from the Electricity Department at an average price of 1·14d. per unit.

The difference between the two figures of 1·14d. and 0·35d. is 0·79d. per unit, which, on the total load of 29,955,070 units, means no less a sum than £98,602, or nearly one-fifth of the total operating costs of £500,023.

Later figures are, however, available for Manchester. During the year ending March, 1909, the track mileage was increased to 181¼ miles, the units of electrical energy used by the tramways being 29,675,249, which were purchased at the reduced average price of 1·04d. per unit. Comparing this with the Glasgow 1908 figure of 0·35d. per unit, there is a difference of 0·69d. per unit, which for the 29,675,249 units represents £85,316.

Making every reasonable allowance for annual charges on the capital cost of a separate generating station, sub-stations and feeders, who can doubt that, so far as the tramways are concerned, the Manchester Tramways Committee would have been well advised to have their own plant?

Compare other towns with practically similar lengths of line, or, preferably, similar consumption of electrical energy, and the results will be consistently in favour of the separate generating station, even after all necessary allowances for extra capital charges have been made.

There is, therefore, no wonder that great dissatisfaction with tramway power tariffs exists; and as the economics of power production become more clearly understood, tramway undertakings will naturally be more and more averse to having their rates calculated with reference to the annual charges on the whole capital expenditure of the supply undertaking, and not on that part alone which directly concerns the tramway power supply. If the prices were determined on this basis, there is no reason why the prices charged to the tramway should not be comparable with the total costs at which they could generate for themselves.

Municipal Trading.

An interesting example of municipal trading methods was revealed at Sheffield recently. The Education Committee was considering tenders for the electric lighting installation in a new hostel for men students; 13 tenders were received, ranging from £94 to £328, and a sub-committee recommended for acceptance that of the Corporation Electric Supply Department at £155. Exception was taken to this, however, and an amendment was moved to give the contract to a firm which quoted £28 less than the Corporation department—a firm of high standing, and approved by the architects. The lowest tender (£94) was barred on the score of the inexperience of the contractor.

It was argued by the supporters of the Corporation tender that the higher quality of the work done by the department was well worth the difference of £28, and that no business firm possessing a works department would think of getting an outside contractor to do work that his own staff could do; but both these specious arguments were promptly knocked on the head. It was denied that the Corporation department would do the work better than a contractor, and the folly of doing work at an unnecessarily high cost was pointed out. The injustice of inviting contractors to tender, if it was a foregone conclusion that the Corporation department should get the job, was also exposed, and the amendment was carried by a considerable majority.

One speaker, who voted for the amendment, expressed surprise that outside tenders had been invited at all, and urged that in future any department of the Corporation should serve any other department at cost price, plus a small and reasonable percentage for profit. He appeared to overlook the fact that, in the absence of competition, there would be absolutely no check upon the performance or charges of the department, while the definition of "reasonable profit" would offer an interesting problem. We maintain that where a municipality possesses wiring powers the interests of the ratepayers cannot be properly served unless the wiring department is run on a competitive basis, and is required to show a separate profit and loss account at the end of each year's working. If it cannot show a balance on the right side, it is plainly not justifying its existence, for it is no part of the orthodox theory of municipal trading that customers should be subsidised or a trading department run at a loss.

Electric 'bus Developments.

According to our contemporary, the *Automobile Owner and Steam and Electric Car Review*, one unlooked-for effect of the new police regulations requiring the future 'bus not to exceed 3½ tons in weight, has been to draw attention to the electric vehicle. At first sight, it would certainly appear that the electric 'bus, owing to the considerable weight of its

accumulators, would be almost a last resort under the circumstances; but, again according to our contemporary, the accumulators are not taken into account in estimating the weight of this type of omnibus. This curiously one-sided arrangement certainly presses hardly on the petrol-driven vehicle, and almost bears out the suggestion that the police are trying to shoulder out such vehicles on account of the many complaints received as to noise and smell. Nevertheless, believers in the electric 'bus, and electrically-driven vehicles generally, have every reason to rejoice in the prospective developments which should take place.

Our contemporary advances the opinion that any considerable curtailment of existing capacity in the petrol vehicle would render it unprofitable to run, and states that the Vanguard Co. has actually converted some of its petrol-motor chassis to electrical driving, apparently on similar lines to the well-known Electrobus, and that vehicles have been privately tested with satisfactory results.

If our contemporary is accurately informed—and we have no reason to suppose otherwise—there appears to be a good time ahead for the electric 'bus, which has everything to gain by a greatly extended use in the way of improved construction and efficiency. The subject brings others in its train, for the extensive use of battery vehicles would inevitably lead to the much-needed provision of charging facilities throughout the metropolitan area, and thus possibly remove one of the most serious objections at the present time to the adoption of electrically-driven vehicles generally for trade purposes. Judging by American contemporaries, the American station engineer has taken the battery charging business more seriously than his British *confrère*, and special departments have been organised to look after this class of business, with good results.

Of course one has to admit that the electric vehicle is much more popular in the States than here—possibly due to the greater encouragement given by those interested in its progress—but, nevertheless, the matter seems, in view of possible developments in the metropolitan area, to be worth some concerted action on the part of London central station authorities.

An Engineer's Responsibility.

When a man enters a lawyer's office with the intention of fighting a case, he does not ask advice from the lawyer and ask him at the same time to guarantee a win. If he consults a doctor, he does not make recovery from an ailment a *sine qua non* of payment of the man's fees. Engineers, however, are sometimes credited with a degree of prescience more complimentary to them than to the intelligence of their clients.

Some 15 years ago, an engineer interviewed a large number of station and other resident engineers in London with a view to pointing out to them the waste they were incurring by buying water at 8d. per 1,000 gallons when they could pump a softer supply for about ½d., plus capital costs, or, say, a total of 1d.

In only one central station was any success attained. In that one case, the advice of the engineer in question was listened to, and the well paid for itself three times over, the first year it was at work.

Usually the only response to be obtained from the engineer-in-chief was a request for a guarantee that there was water to be reached by boring for it. It might be pointed out that successful boreholes were in operation on all sides, and that ordinary reasoning warranted the supposition of equally successful finding in the middle of so much success. It might be pointed out that no London borehole had been made anywhere near the particular spot that did not produce so much water as to warrant a boring being made, even if all the water required was not obtained. But it was always the guarantee that was demanded.

Many of those same stations did ultimately have borings made, and probably are in a position to tell to-day, if they would do so, how many thousands of pounds of shareholders' and ratepayers' money were thrown away in the years between. Other engineers can probably cite similar instances where men who occupy engineering positions have endeavoured to throw all risks upon some outsider, themselves shirking the responsibilities of the office they are paid to occupy. Such shirking is derogatory to the dignity of the profession, and cannot fail to prevent that proper recognition of the status of the engineer for which all of us are calling. The engineer at the head of any undertaking ought to be fitted to form correct judgments on the propositions that are put before him; otherwise he is not properly qualified for the post he occupies.

REVIEWS.

Cranes. By A. Böttcher. Translated by A. Tolhausen. London: Constable & Co. Price 42s. net.

This is a large work of about 500 pages, dealing with the design and construction of a large number of different forms of crane. It is not confined to electric cranes, but includes also those driven by steam and hydraulic power.

The book owes its inception to the fact of the author having been engaged by the Vulcan Co., of Stettin, to supervise the rebuilding of their works and the rearrangement of their cranes, and embodies the results of the experience and information gained in the course of the work.

The treatment of the electrical portion of the subject is somewhat meagre, and the chief interest of the book is mechanical rather than electrical. The author has devoted himself particularly to the design of the structural steelwork, and this, together with the many excellent drawings in detail of German cranes, constitute the really valuable portion of the work.

Part I is a summary of the scientific principles underlying the design of crane structures and machinery, and constitutes a short treatise on applied mechanics.

Part II deals with the general arrangement of cranes, and contains a large number of drawings showing the arrangement of almost every known form of crane.

Section 5 of Part III will be of interest to electrical engineers, as it treats of the principles of electrical driving. Curves are given of the relative performances of direct-current series and shunt motors, and three-phase alternating motors, and diagrams of starters and controllers, but, as already stated, the treatment is merely general and somewhat meagre.

Part IV contains much useful and valuable information relating to the design and construction of details of the machinery of cranes, automatic brakes for controlling the lowering being dealt with very fully.

Part V is one of the best sections of the work, as it deals with a subject which the author seems to have made his speciality, namely, the design and calculation of plate and lattice girders. Stress diagrams are given both for static and rolling loads, and in connection with this section, tables are given at the end of the book of moments of inertia, &c., for a number of sections, including I girders of built-up section.

The succeeding part is on crane installations. In this section, drawings are given of a number of German cranes, and in each case the loading of the different parts, the unit stresses, and the driving powers are all worked out in detail. This represents an enormous amount of work, which can probably only be fully appreciated by those who have worked out similar details themselves. The latter portion of this section contains descriptions of English and American cranes, but does not compare in value with the first portion, as the information and illustrations given are only such as can be found by reference to the catalogues of the various firms whose cranes are described.

The book concludes with various tables, and with an index of articles and papers on the subject of cranes.

With regard to the work of the translator, we can appreciate the difficulty of turning the highly technical German into equally technical English. Here and there the German sentences have been translated literally, with a result which is somewhat reminiscent of "Ludwig in London"; but this does not detract from the value of the work, and we congratulate Mr. Tolhausen on the successful completion of his heavy task.

ELECTRIC POWER IN THE WORKS OF MESSRS. ARMSTRONG, WHITWORTH & CO., LTD., MANCHESTER.

The name of Messrs. Armstrong, Whitworth & Co., Ltd., is too well known to engineers and shipbuilders to require any introduction in the nature of a description of this firm's rise and progress. It is only necessary to consider the large measure of confidence reposed in the firm by the Admiralty and War Office of this country, and the large number of orders which are received for military and naval equipments from other countries, in order to recognise in them an impressive testimony to the standing occupied by the firm whose name has become a household word; and the only unfortunate effect of such fame is to tend to make one to a certain extent oblivious of the fact that, in addition to works of this large order, the firm also undertake the construction of machine tools, motor-cars, electric plant, pressed work, forgings and steel manufacture on a scale which is, perhaps, unparalleled by any private firm in this country. Inasmuch as the Manchester works were originally commenced under the control of that master of engineering research whose name is perpetuated in the most eagerly coveted scholarships of the country, it may be interesting to describe in some detail the way in which electric motive power has entered into the operation of the Manchester section of this undertaking.

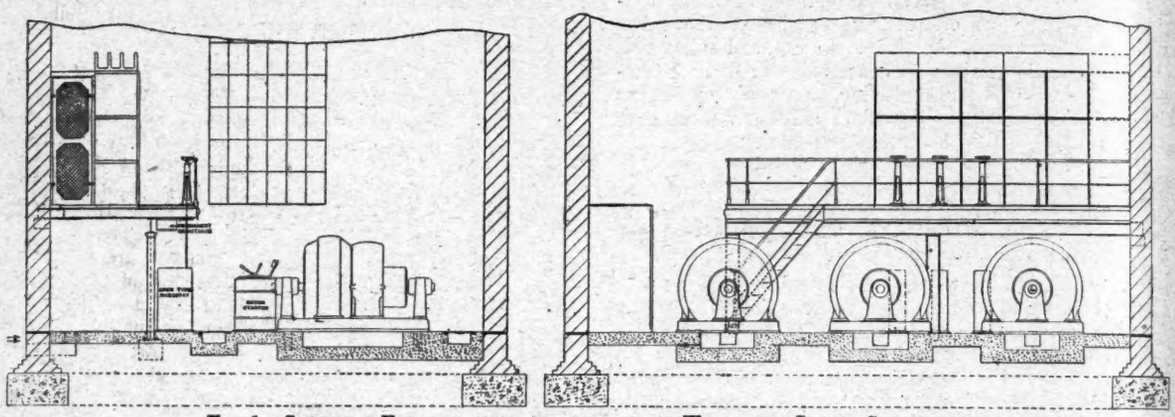

Fig. 1.—Sectional Views showing arrangement of Whitworth Street Sub-station.

Electric power as first used by Messrs. Armstrong, Whitworth & Co., at Manchester, was generated in their own station, which is still in operation, and takes the bulk of the load, supplemented by an auxiliary supply from the Manchester Corporation electrical department, and it will be useful first of all to describe its development. The generating station is situated in the geographical centre of the old works, in order to render the lengths of distributing cables in each direction as uniform as possible, and to equalise the voltage drops on the system. The first set in the generating station was set to work in 1898 and consisted of two Schuckert dynamos giving 250 KW. each for power and lighting at 220 volts. These were direct coupled to Browett-Lindley enclosed vertical engines running at 310 R.P.M. supplied with steam at 160 lb. pressure. As all the water in the generating station had to be obtained from the town mains, all the engines ran non-condensing. At the middle of 1899 it was found necessary to install another set of 500 KW. capacity running at 180 R.P.M. In 1900 an 800-KW. set consisting of a dynamo coupled to a Browett-Lindley vertical engine and running at 150 R.P.M. was installed, and in 1904 owing to the rapid spread of the use of electric motive power in the works, an Armstrong-Whitworth dynamo, built at the Elswick works of the firm, and coupled to a Browett-Lindley engine, running at 150 R.P.M. and giving 750 KW., together with an Armstrong-Whitworth combined set consisting of a 250 KW. dynamo and an enclosed high speed engine running at 350 R.P.M., were installed.

The increase in the power requirements of the firm still continued and the ground space was by this time valuable. As more power was wanted an arrangement was made with the Manchester Corporation Electricity Department in 1907, whereby a bulk supply was brought to a transforming station about 12 yards away from the private generating plant. The supply of three-phase current at a pressure of 6,500 volts was commenced on January 19th, 1907, and two feeders of 1,000 KW. capacity each are now laid from Stuart Street generating station with an interconnector with the North Street sub-station, feeding Messrs. Armstrong, Whitworth's new works situated some 700 yards from the Whitworth Street or old works sub-station.

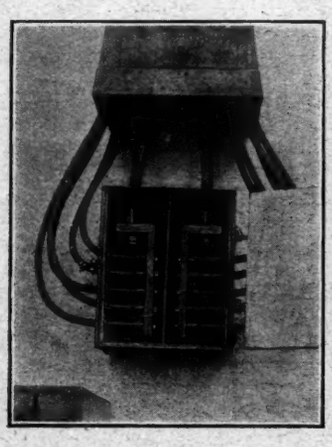

Fig. 2.—Ironclad Distributing Box.

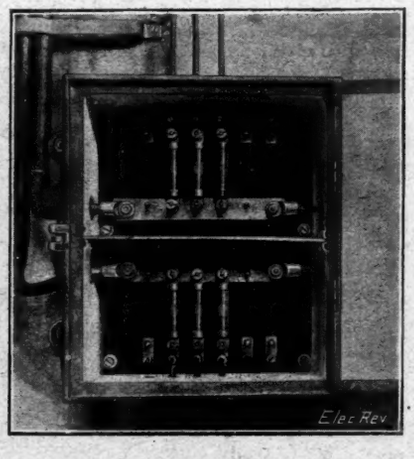

Fig. 3.—Sub-distributing Box, Supplying Motor Circuits, &c.

The Corporation sub-station at Whitworth Street, elevations of which are given in figs. 1 and 2, is of 2,000-KW. feeder capacity, and the high-tension switchboard contains panels for two feeder switches, one interconnector switch and three machine panels. The board is of the Ferranti cellular type, and is mounted on a concrete and iron gallery. The space underneath is intended for the reception of transformers for a three-phase static supply should it be required. At the present time, however, three Bruce Peebles converters, manufactured under the La Cour patents, each of 500 KW. capacity, are installed, and convert from 6,500 volts three-phase, at 50 periods, to 220 volts direct current, when running at 375 R.P.M. The alternating and direct-current machines of this set are mounted on combined bases,

and the whole set is of the two-bearing type. The direct current ends are arranged to give 220 volts at no-load and 230 volts at their normal full load of 500 KW. These sets have a large overload capacity and an exceedingly high efficiency, especially at the lighter loads, this being much higher than can be obtained with any motor-generator. The advantage is also gained that the power factor is practically unity at full load, and there are, of course, no transformers used in conjunction with these machines, the high-tension current being taken direct to the stator windings. This type of machine has proved so successful in operation, that with the two machines above referred to, there are now over 30 motor-converters running on the Manchester Corporation extra-high-tension system, varying in size from 150 to 1,500 KW. capacity each, particulars of which have appeared from time to time in our pages.

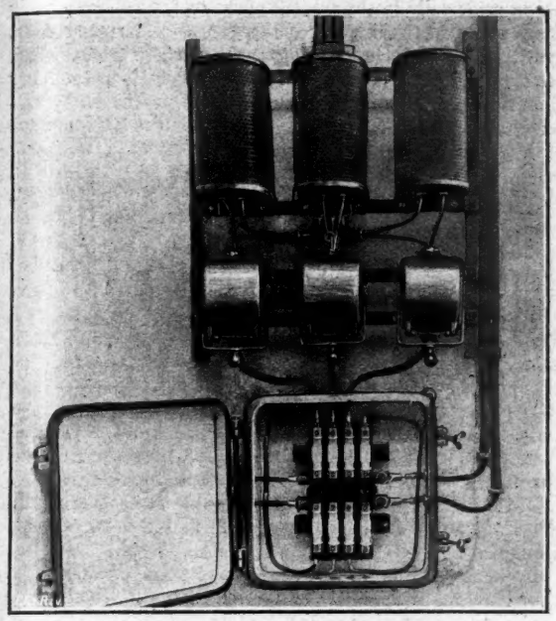

FIG. 4.—LIGHTING SUB-DISTRIBUTION BOARD, WITH FOUR-WAY BOX.

The high-tension switchboard panels conduct the current direct through Ferranti oil-break switches with a charging arrangement in order to smooth down voltage oscillations on the feeders, which are about 1¼ miles in length from the Stuart Street switchboard to the sub-station. These charging arrangements consist of glass water pots in the form of cylinders, at the bottom of each of which is fixed an electrode or terminal, and which also contains a vertical sliding electrode connected to the switch handle, so that the moving electrode slides down in contact with the fixed electrode as the switch closes. The feeders enter at the bottom of the board, a tapping being taken to the potential transformers, the main circuits passing to the oil break switch, and thence upwards to the bus-bars at the top of the board. Suitable current transformers, ammeters, voltmeters, maximum time-limit relays, &c., are provided, and spark gaps are provided for discharging surges. For energising the power factor indicator and integrating wattmeter, a three-phase potential transformer converting from 6,500 to 100 volts is provided, furnished with dust fuses in a concrete cubicle at the side of the board. The converter panel connections are generally similar to the feeder arrangements, the cables passing down from the bus-bars, through suitable measuring instruments, to the oil switch, and so to the bottom of the board. Isolating switches are provided so as to cut off any cubicle from the high-tension supply when this becomes necessary for cleaning or repair. An additional feeder panel was installed to accommodate the high-tension link between the Whitworth Street sub-station and the new works at North Street, to which reference will be made later.

The low-tension board, which is also mounted in the same gallery at a distance of 10 ft. to the nearest point of the high-tension board, contains three sets of circuit-breakers of 3,000 amperes capacity each, fitted with overload and reverse-current cut-outs, and manufactured by Messrs. Bertram Thomas, of Manchester. The switchboard consists of three panels 4 ft. 3 in. × 1 ft. ½ in. The left-hand panel contains a Kelvin & White electrostatic voltmeter on the upper portion, and a 3,000-ampere circuit-breaker on the lower portion. On one of these generators the circuit-breaker is arranged for overload and reverse operation. It is the intention of the firm to have the remaining breakers fitted up in the same way, but at present these provide for overload only. The right hand of the panel carries a 12-in. scale ammeter reading from 0 to 2,500 in the upper portion, and in the lower portion a circuit-breaker for a capacity of 3,000 amperes overload only. The circuit-breakers have laminated edgewise brushes, and open circuit in a strong magnetic field. The main brush is protected by adxiliary metallic contacts, no carbon being used at any part. The circuit-breakers are also provided with loose handle attachment, so that if closed on the circuit when an overload exists the breakers will immediately open the circuit again in spite of the handle being held. Also the arrangement is such that the circuit-breaker cannot be closed unless the reverse current attachment has been set. The features of these circuit-breakers are the very large opening of the breakers, the strong magnetic field, the good arrangement of the brushes for cleaning their contacts and enabling each leaf of the brush to make its own separate connection with the block, and the very strong construction of all mechanical parts. The whole board is necessarily of a very simple character, and the back is kept very clear, unabling all bolts and nuts and connections to be easily got at.

Shunt regulation is also provided for the direct-current side of the converter, which supplies current to a two-wire, 220-volt board, feeding a 220-volt two-wire system of distribution. The necessary voltmeters and ammeters are also installed.

This low-tension board is coupled to the bus-bars of the private generatimg station by means of copper bus-bars, carried overhead and protected from the weather; these bars having a current capacity of 6,000 amperes, and a length of 72 ft. from bus-bar to bus-bar of the switchboards. The Corporation supply is thus in parallel with the private plant, and during the day when the power requirements are at the heaviest, the Corporation supply takes up the bulk of the running, the private plant taking the remainder, which includes the most important departments. At night it is usual to run an 800-KW. set of the private plant for the purpose of running the works lighting and incidental motive power, thus relieving the Corporation of about 500 KW. of load.

The switchboard in the works generating station has passed through a series of progressive steps coincident with the additions to the electric generating plant. As a result, a series of panels has been evolved which in their construction are purely the outcome of Messrs. Armstrong, Whitworth's own design, based on the needs of their peculiar requirements. The switchboard is divided into two sections, so far as its distributing panels are concerned, one section consisting of 12 panels dealing with the lighting of the works, the other section, at present of 22 panels, with provision up to 30 panels, being utilised for the power switchboard. The lighting circuits each consist of 0·3 sq. in. feeders, running to suitable points in the works, and the positive pole of each feeder is protected by an overload circuit-breaker of considerable strength and solidity. The positive cable is led in at the top of the back of the board to the circuit-breaker, and through it to the positive bus-bar. The negative cable is led in at the front and bottom of the board, and passes through a single-pole switch and fuse of the porcelain tube variety, and a meter to the negative bus-bars. As each panel is 6 ft. long and 12 in. wide, it will be seen that it is practically impossible for a workman to cause a short-circuit between positive and negative behind the board without wilful carelessness. Each panel is constructed to carry 250 amperes, and the feeders go to main lighting boxes in different parts of the works.

The same system is followed for the power panels with a few minor differences. Each panel is 15 in. wide and 6 ft. long, and designed to carry 1,000 amperes passing to

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a 1 sq. in. feeder. A Whitworth circuit-breaker controls the positive pole, and the negative has two knife switches mechanically coupled together, of a similar type to those on the lighting board. The porcelain-covered fuses are replaced by strips of sheet-copper of considerable section, these being very rarely blown. In the event of a fault, the circuit-breakers on the positive poles are relied on to take the break, and the only possible conjunction of events which would cause the negative strips to fuse, would be, say, three or four leaks on the positive, and an earth on some negative main. Even then it is possible that the positive circuit-breakers of the two circuits effected would be tripped. Having regard to the considerable amount of horse-power behind the circuit-breakers and the capacity of the cables, it is evident that the breakers must be designed to give a very smart and safe interruption of circuit, and for this reason there are three breaks on each circuit-breaker, in parallel with one another. The first is on the main contact, which consists of a laminated copper brush pressing on the surface of the copper block. The second break occurs on a copper auxiliary spring contact, while the final break takes place through carbon tips. In addition to the power and lighting panels on this board, there is a 5,000-ampere double-pole circuit-breaker for controlling the supply to the board from the 800-KW. generator. There are also circuit-breaker panels provided for the 500-KW. set, and one by Messrs. Armstrong, Whitworth & Co. for the 650-KW. set, together with a panel for the starting of the motor-generator installed in the works generating station, for a reason to be mentioned shortly. At the centre of the board is a small panel for the station lighting, containing four double-pole switches, and eight single-pole fuses. The total length of the main switchboard is 65 ft. In the case of the 250-KW. sets the control panels are independently placed with regard to the main switchboard, and are situated close to their generator. This is because of the fact that owing to the rapid extension of the generating station the main smoke stack for the boiler equipment happens to occupy a position in the centre of the generating station, and it is, therefore, impossible to see a considerable portion of the board from these machines. As it is always advisable for the man who is putting in a machine to be able to see exactly what is happening on the set at the time he is regulating and switching in, the panels, which were made by Messrs. Armstrong, Whitworth & Co., and fitted with circuit-breakers, are placed in the position mentioned above.

Mention was made of a motor-generator installed in this generating station which is used for testing machine tools made by the firm, and also in order to provide an earth return through the motor-generator for some of the motors requiring earthing used throughout the works, such as those used in the various shops to drive trolley cars and other apparatus. The generator is mounted on the same shaft as a motor of 200-KW. capacity. Its normal speed is 450 R.P.M., but by varying the shunt resistance on the motor, a 25 per cent. variation is obtained. By this means and by varying the field resistance on the generator a variation of voltage for testing purposes of from 80 to 220 volts can be obtained. It will be seen that the ground space of the private generating station is of necessity over-well filled, and it is therefore interesting to give a comparison of the ground space per KW. installed required in the private plant and the Corporation sub-station respectively. The first figure is 2·4 KW. installed per sq. yard, while the second is 14 KW. installed per sq. yard, thus showing the very important advantage of Corporation bulk supply for power and works lighting purposes, from the point of view of space. The steam plant in this generating station is fed from a battery of boilers which is common to the whole works, and it may be incidentally mentioned that elsewhere, throughout Messrs. Armstrong, Whitworth's establishment, steam is only used for a section of steam hammers, and a single steam engine of large capacity, which is used for the main rolling mill for manufacturing armour plates, requiring upwards of 10,000 H.P. to drive it.

The system of distributing the power throughout the works adopted by Messrs. Armstrong, Whitworth & Co., is of considerable interest, as it embodies the result of experience on a very large scale. The power feeders of 1 sq. in. section are run from the generating station, which, as mentioned, is linked up to the Corporation sub-station. Most of the works are under cover and practically the only section of pole line distribution is to be found immediately outside the generating station, where an H-frame with suitable insulators is fixed for carrying the leads out to the various destinations. In the shops the cable is run principally in the tie rods of the roof, wood cleats being fixed to these having holes for the cables spaced 4 in. apart. The cables are strung through these cleats, which are then tightened, and hence, as the roof spans are fairly close together, the weight of the cable is so uniformly distributed throughout the building as to render this method of distribution very safe. It has the further advantage of being inexpensive and of leaving the cables free of all obstruction to plant and cranes. This method also lends itself admirably to rapid work in installation. As an example of this, 1 mile of 1 sq. in. cable was installed in cleats already fixed, in a week-end of 20 hours by the electrical staff attached to Messrs. Armstrong, Whitworth's works. This probably constitutes a record in high-speed cable fixing. All main cable is of 300-megohm C.M.A. grade, insulated with paper-vulcanised rubber, taped and braided, made by Messrs. W. T. Glover & Co., Ltd.; these cables being run to distributing boxes of an ironclad type. On the walls of the shops the cables are brought down to these boxes through troughs of wood, whose ends near the box are splayed out for convenience in bringing the cables into the boxes. A view of one of these boxes with the front open is shown in fig. 2, and the very simple arrangement of circuits therein is well displayed.

From the middle bus-bar shown, five pairs of 0·3 sq. in. mains pass direct to similar distributing boxes, fig. 3, and thence to the motors and other energy-consuming devices as required. Due regard is paid in this portion of the installation to the proper reduction of cable section consistent with a limitation of voltage drop. An example of this is found in No. 2 bay of the heavy gun shop of the works. There are here three large lathes, each driven by a 60-B.H.P. motor mounted direct on the lathe. The 0·3 cable from the main distributing box is brought direct to the first motor, and through this to the second motor, while from the second to the third motor is looped a power circuit having conductors of 0·25 sq. in. section; thus 1 sq. in. cable feeds 0·3 cables, which, in turn, feed into 0·25 sq. in. cables, and, as the result of experience obtained in these works, it is found that the current-carrying capacity of a main power cable reckoned at a density of 1,000 amperes per sq. in., should be about one-third the total nominal capacity of the machines connected to it. This figure is a variable quantity for different classes of work, and may be taken only as an average value for industrial motors in works of this description.

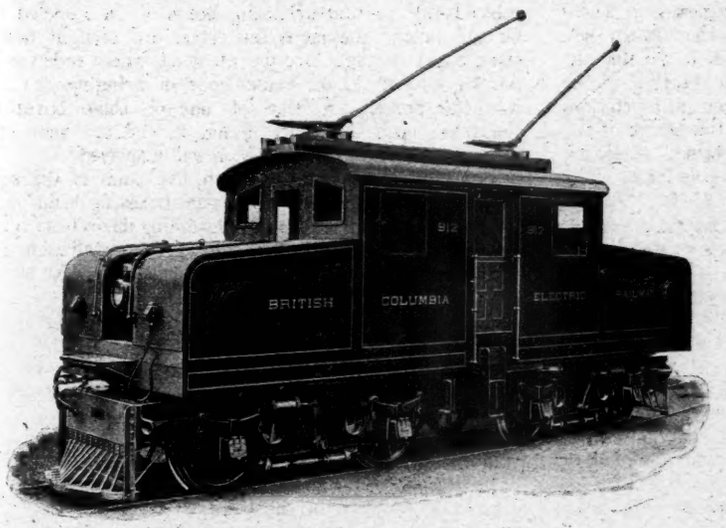
The lighting cables from the panels on the main switchboard are run in the same manner as the power cables described above, to ironclad wall-boxes, from the bus-bars of which are carried four 50-ampere circuits suitably fused, while from the bus-bars of this first wall-bracket a 0·15 sq. in. feeder is carried to a similar box in another adjacent shop, or portion of a shop, where it is required. Each 50-ampere circuit goes to a pair of bus-bars in a sub-distributing box (fig. 4), feeding four 10-ampere circuits utilised for arc lighting and other illumination, while from the sub-division box another pair of 0·15 sq. in. cables passes to a similar adjacent sub-distribution box of four 10-ampere circuits. It is thus seen that each main circuit of 250 amperes capacity feeds two sub-circuits of 150-ampere capacity, each of which feeds two branch circuits of 50 amperes capacity, either of these last two circuits feeding two sets of four circuits each of 10 amperes capacity. It is thus seen that the principle of proportioning current-carrying capacity to the normal, and not the full lighting requirements, is followed out throughout the system. Moreover, by this system of sectionalising the circuits and interposing fuses, a fault on any one circuit can be easily located and isolated. The large ironclad wall-boxes for power and lighting purposes were made by Messrs. Armstrong, Whitworth & Co. themselves, while the smaller boxes were obtained from Messrs. Eckstein, Heap and Co. The lighting wires are carried either in steel tube

casing and capping, or porcelain cleats, as is best adapted for the requirements of each shop. The switches used for controlling the circuits are of the enclosed gas-tight, waterproof type, and on the last distributing box three circuits are appropriated for arc lighting and one 10-ampere circuit for the incandescent lighting distributing fuse box by means of which not more than five amperes are allowed on any one incandescent lighting circuit. It will, therefore, be seen that the lighting arrangements of this series of works have been carried out in a way which should contain considerable instruction to manufacturers who are grappling with that always great difficulty in industrial concerns, the efficient and safe distribution of factory lighting.

(*To be continued.*)

ELECTRIC LOCOMOTIVES FOR BRITISH COLUMBIA.

Through the courtesy of Messrs. Dick, Kerr & Co., Ltd., we are enabled to illustrate some electrical locomotives recently built by them for the British Columbia Electric Railway, the electrical equipment being supplied by their Preston Works, while the mechanical work was turned out at their Kilmarnock Works. These locomotives are of the four-axle type, with one motor per axle, and have a maximum rated tractive effort of 16,000 lb., while the maximum instantaneous effort is 25,000 lb. A feature of interest is the system of coupling the two trucks together, by means of a massive hinge, having lateral flexibility, but vertical rigidity. This arrangement prevents any tendency to tilting of one truck by another.

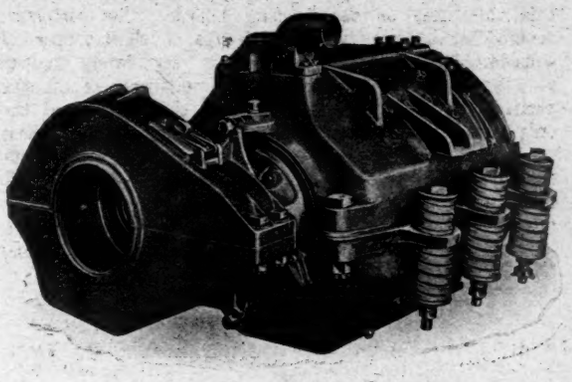


Dick, Kerr Electric Locomotive for British Columbia.

The centre pins and cab platform framing are not subjected to any longitudinal stress, except that due to inertia when starting and stopping, the whole pull of the motors being transmitted direct from the motors through the trucks.

The spring suspension is of the locomotive type, the weight being carried by semi-elliptical springs resting on the journal box saddles.

An interesting view shows the cab interior, with the two master controllers, one at each end; the contactor boxes, circuit breakers, switches, &c. The control equipment is of the standard Dick, Kerr multiple unit type, with series magnets operating the various contactors. The resistances are placed in the sloping ends of the superstructure.



Dick, Kerr Motor used on Locomotive.

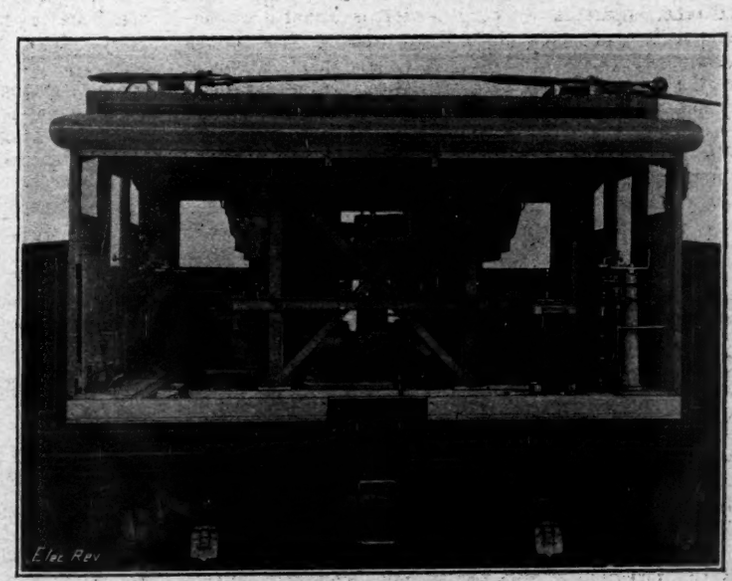
Each of the four motors, when operating on a 600-volt circuit, will give a tractive effort of 4,000 lb. on the periphery of the 42-in. wheels and a speed of 15 m.p.h. at the one hour rating; each motor is fitted with reduction gear having a ratio of 3 64 to 1.

The armature bearings are lubricated by oil rings which are specially designed to prevent flooding when running at high speeds; the axle bearings are lubricated by a system of wicks immersed in oil wells, and no grease is used as an emergency lubricator. The gearing is enclosed in malleable iron oil-tight gear boxes, supported by the axle bearings at one end, and by the pinion bearings and motor shells at the other end.

The motors are provided with forced ventilation, the air, which is blown into the motor shell at the end farthest from the commutator, passes out at suitable openings provided at the commutator end.

The air for the forced ventilation is obtained by means of a centrifugal blower situated in the centre of the cab, and driven by a Dick, Kerr motor; the controller for operating this motor is situated near the right-hand master controller seen in our view of the cab interior.

An electrically-driven air compressor with suitable air



Interior of the Cab, showing Controllers, Ventilating and Brake Equipment.

reservoirs is provided for the air-brake equipment, the locomotive being fitted with combined straight and automatic air brakes; this compressor is mounted above the ventilating blower in the cab.

Two current collectors are provided, of the straight underrunning trolley type, the current being collected from an overhead trolley line. The trolleys are equipped with retrievers.

The total wheel base of the locomotive is 24 ft. 6 in.; the wheel base of each truck 8 ft.; and the length overall 35 ft. 7 in. The total weight of the locomotive is 50 tons.

ENGINEERING DAY AT THE WHITE CITY.

Last Saturday was "Engineering Day" at the White City, and great efforts had been made by the Organising Committee to ensure its success. The object was to afford a meeting place for engineers, irrespective of the particular branch of work in which they were engaged, and so promote the feeling of unity which, in these days of specialisation, is very apt to be forgotten. It was unfortunate that the weather was so unfavourable, as this, no doubt, affected the number of visitors. The White City has such a reputation to live up to, that those who compared the attendance on wet days last year with the total of engineering as well as ordinary visitors last Saturday could not help confessing a feeling of disappointment, which possibly the actual state of affairs did not warrant.

The proceedings may be divided up into three parts—first, the personally conducted tours round the principal engineering exhibits and the inspection of the machinery used in connection with the various amusements; second, the course of engineering lectures in the Congress Hall; and third, the reception by the Lord Mayor of London in the afternoon and the banquet in the Garden Club Banqueting Hall, under the chairmanship of the Hon. A. Stanley, M.P., in the evening.

Had the weather been finer, there is no doubt that the opportunity to see how the various side-show amusements were operated would have proved the most popular feature of the day. As it was, a number of parties under the guidance of members of the Committee braved the elements and were shown the flip-flap, wiggle-woggle, spiral railway, Canadian toboggan, witching waves and scenic railway, as well as Messrs. Joseph Baker & Sons' complete equipment of machinery for bakers and confectioners, Messrs. McVitie and Price's biscuit-making machines, Messrs. Lyons's producer gas refrigerating plant and the sub-station supplying electrical energy to the Exhibition. This is the first time that many of these features have been open for inspection, and all agreed that the engineering genius shown in working out the details of the side-show amusements was of a very high order. Special displays were also arranged at many of the exhibits in the Machinery Hall, but those who expected to see the commercial process of "hydrogen" being extracted electrically from the atmosphere, as promised in the official programme, were disappointed, the more prosaic, but possibly more useful, process of making nitrate of lime, as carried on at Notodden in Norway, taking its place.

It is not possible here to give any detailed description of the engineering exhibits, which, though far inferior both in number and range to those on view last year, will yet repay careful inspection.

Perhaps the two of greatest interest to the electrical engineer are the Cowper-Coles display of electro-metallurgical processes, and the "Silundum" electric cooking appliances on view in the "model house" fitted up in the grounds by "Simplex Conduits, Ltd."

The second division of the day's activities consisted of a series of six lectures delivered in the Congress Hall near the cascade, the first being given at 2.45 p.m. and the last at 7.0 p.m. The first related to water-power and turbines, the second and third—arranged by the Institute of Marine Engineers—dealt with the uses of electricity on shipboard and the treatment of marine boilers on long voyages respectively; the fourth showed the present position of the large gas engine, and the last two the applications of a new method of teaching drawing to the needs of architects and engineers. It will be seen that all branches of engineering work were as far as possible considered. Many of the lectures were illustrated with lantern slides, and it was gratifying to find they were well attended.

Mr. W. B. Bryan, M.Inst.C.E., presided at the lecture given by Mr. Alph. Steiger, M.Inst.C.E., on "Water-Power and Turbines."

The lecturer pointed out the erroneous character of the general belief that the water powers of this country were of little value, and instanced the Foyers, Kinlochleven and North Wales electric power installations as examples of what might be done. He was of opinion that at least 1 million B.H.P. might be utilised in this country. He acknowledged that the cost of the works necessary to utilise this power would be very great, and might average as high as £40 per B.H.P., but the low working costs would to a very large extent counterbalance this disadvantage. The developments which were taking place in electro-metallurgy, especially in regard to the electric furnace for iron smelting, would make cheap power more than ever a necessity of the near future, and would justify the most careful examination of our available sources of water power. Whereas the cost of coal was practically proportional to the power developed by a steam plant, the incidence per unit, or per B.H.P.-hour, of the capital charges of a water power were reduced as the load factor was increased.

The lecturer then referred to the different types of water-wheels and turbines, pointing out that the modern turbine was three times as efficient as the overshot water-wheel, and he exhibited some diagrams showing how closely the speed of a turbine could be governed throughout wide ranges of load, concluding by referring to the water-power plants on the Continent, and the Swiss scheme to spend six millions of money on improving the canal communication between Basle and Lake Constance, which it was expected would render available for commercial use 150,000 B.H.P.

The two Institute of Marine Engineers' lectures were presided over by Sir Fortescue Flannery, M.Inst.C.E. The first paper, by Mr. J. McLaren, outlined the economies which could be effected by driving all the auxiliaries on board ship electrically, generating the power by a gas engine supplied from a suction gas producer. The paper is a strong condemnation of the steam-driven hoists, winches, capstans and refrigerators at present used, pointing out their inefficiency and cost as well as the inconveniences often met with in working them, and proposing to use alternating electric currents not only for driving all auxiliary machinery but also for lighting and heating the ship, as well as for all cooking purposes. The author claimed that during a discharge of cargo the fuel used would be only one-fifth of the amount required for ordinary steam working—though by a misprint in the paper itself the figure appears to be twice as great—and the total saving of fuel would far more than repay any additional capital outlay on the gas and electrical plant.

The second paper, by Mr. H. Ruck-Keene, dealt with the treatment of marine boilers on long voyages. The conditions under consideration are so different to those met with in electric power work that it may be said no comparison is possible. At any rate, the care required to keep salt out of the boiler, and the absolute necessity of keeping up steam without intermission for weeks at a time, differ from land practice, but the importance of constant, careful inspection of gauge glasses and the need for keeping oil out of the feed water is the same for all boilers, and the information and warnings on these points given in the paper might be read and heeded by all in charge of steam-raising plants.

The large audience showed that to many the chief event of the day was Mr. Percy R. Allen's lecture on "Large Gas Engines," presided over at 5.30 p.m. by Mr. Dugald Clerk, M.Inst.C.E. The lecturer commenced by describing the Otto cycle of working, and the general construction of the usual pattern of horizontal engine. The impetus given to the industry by the late Mr. B. H. Thwaites's demonstration that blast-furnace gas was a suitable fuel for gas engines was then mentioned, and the developments which have during the past fourteen years taken place on the Continent in the use of this gas, with large gas engines, were

described. It was mentioned that the 600-H.P. gas-driven blowing engine shown at the Paris Exhibition of 1900 was still at work at Messrs. Cockerill's blast furnaces at Seraing. The two-cycle method of working, as developed in both the Körting and Oechelhäuser engines, was explained, and a number of slides gave a very fair idea of the present position of the industry abroad. The lecturer then dealt with the general design of large gas engines, as shown both in America and Continental practice, pointing out that the vertical pattern gas engine had been adopted to a far larger extent in this country and America than on the Continent.

The various methods of governing and the heat efficiency of the engine then received attention. As regarded the possibility of utilising some of the waste heat in the exhaust, the lecturer stated that: "An ordinary gas engine may be roughly reckoned to consume about 70 cb. ft. of producer gas, having a calorific value of 145 B.TH.U. per cb. ft., per B.H.P.-hour, and this will be found to raise about 2 lb. of steam at 70 lb. pressure for each B.H.P. exerted."

Passing on to the subject of gas producers, the early work of Wilson and Dowson, and the development of the suction gas producer, were referred to. The Mond and Duff bituminous coal producer was also explained, and since the lecturer has had under his control for the past seven years at Weston Point, near Runcorn, a plant of this type capable of gasifying 700 tons of fuel per week, it says much for its efficiency that he "can readily testify to the absence of trouble and the economy resulting from its use."

The question of ammonia recovery was then considered, and in view of the large yield—from 90 to 100 lb. of ammonia sulphate per ton of fuel gasified—and the probable increased demand for this compound for use as a fertiliser in the future, the lecturer considered their higher capital cost and maintenance fully justified for large plants.

The reliability of the gas engine was shown by the non-provision of spare plant in many Continental steel works dependent upon gas engines for their power, and the extent to which gas engines are being adopted may be gauged from the 24,000-H.P. plant at Bruckhausen, near Duisberg, and the 65,000 H.P. installed in one power house at Gary.

The lecturer then considered the relative advantages of gas and steam plants, and pointed out that in cases where the load factor was high the 25 per cent. increase which at present approximately represented the extra capital outlay on a 10,000-KW. gas-driven complete plant over a corresponding steam one was more than justified by the fact that the fuel consumption for a given output was practically halved, and he concluded by pointing out the possibilities of the oil engine when worked on the Diesel principle, mentioning that the coming application of the two-cycle system of working to the oil engine would largely increase its commercial value.

The last two lectures, given by Mr. T. R. Ablett and Mr. C. A. Ablett respectively, described a new method of teaching drawing, the aim being to develop any natural taste or originality the student might possess.

Remarkable results, as shown by the lantern slides, had been obtained with quite young children trained on this system, and there can be no doubt that, apart from the actual value of the power to draw, the trained faculty of observation of a student trained on this principle would be of great value in engineering work.

The reception, held on the terrace of the Imperial Tower at 5.0 p.m. by the Lord Mayor of London (Sir G. W. Truscott), was well attended, and at 7.45 p.m. the banquet was held in the Garden Club Banqueting Hall, under the chairmanship of the Hon. A. Stanley, M.P. Among those present were the Lord Mayor, Sir Fortescue Flannery, Sir Thomas Pile, Sir John Cockburn, Mr. Worby Beaumont, Mr. F. S. Courtney, Mr. Dugald Clerk, Mr. J. W. Orde, Mr. W. B. Bryan, Mr. J. Paxman, Capt. H. Riall Sankey, R.E., and Mr. J. Adamson.

After the usual loyal toasts, the chairman proposed that of "Engineering." Comparing periods within the recollection of many present, he spoke of the advances which had been made in every branch of engineering work, notably in telegraphs and telephones, and the varied developments of the internal-combustion engine which had rendered possible the recent conquests of the air, as well as of the depths of the sea. As evidence that in the advance of engineering, we, as a nation, were not lagging in the rear, he instanced the Assouan Dam in Egypt, which would last as long as the Pyramids, the Forth and Victoria Falls bridges, and the Transandine Railway in South America, which under British auspices was just being completed.

Mr. W. Worby Beaumont, in seconding the toast, explained why the gathering had been arranged, and Mr. F. S. Courtney, on behalf of the Executive, expressed the hope that the results would justify the gathering becoming a recognised annual function. Mr. J. W. Orde, referring to the progress made recently in this country in motor-car engineering work, stated that a few days ago a contract was signed in Paris for the supply of 800 British-made cars for the French market.

Mr. Cornish, in proposing the toast of "Mining and Metallurgy," emphasised the interdependence of the miner, metallurgist and engineer upon each other, and pleaded for more support for British—more particularly Cornish—mining projects, claiming that many of them were far sounder from a financial point of view than the much-boomed foreign schemes which so often ended in disaster.

Sir John Cockburn proposed the toast of "Architecture and Building," pointing out that the tendency in all modern buildings was to depend more and more on the engineer, the outside stonework becoming merely a covering for the steel and concrete lining within, and Mr. F. L. Rawson, M.I.E.E., that of "The Press."

NOTES ON TRADE ABROAD.

(*Continued from page* 374.)

A Foreign Missionary's Report.

FROM the *Canadian Electrical News* just to hand we gather that Mr. H. C. Siddeley, A.I.E.E., the London manager of the Lancashire Dynamo and Motor Co., Ltd., of Trafford Park, left Canada for home on August 13th, having completed a tour of the world in the interests of his firm. The enterprise and initiative of the Lancashire Dynamo Co. is not a new story to us nor is it unfamiliar to many of their friends engaged in electrical trade in this country, and we are sure that as a result of the tour of its London manager the business of the firm will be greatly benefited. Our contemporary remarks that Mr. Siddeley's trip was largely one of inspection, though he reports having also obtained a number of good orders. In Toronto the company are opening up operations through Vandeleur & Nichols, and the first-named partner in this firm (Mr. J. F. B. Vandeleur) was journeying to this country in company with Mr. Siddeley. The following is a brief statement of some of the things ascertained by the latter gentleman in the course of his globe-trotting:—

In India, he states, the chief development work is in the hands of the Government, but a great amount of business was to be expected soon, through the development of the collieries which are being opened up in Bengal. Large irrigation works are also being carried out, and they are being combined with hydro-electric schemes. In the Malay Straits the great tin mines are now being developed extensively by electrical power. In China, great railway projects are being developed, and their works are being electrically driven. In Johannesburg, Mr. Siddeley booked an order for a steam plant, which was shipped from England and placed in operation in the short time of seven weeks.

In Japan, Mr. Siddeley says, they are well advanced in matters pertaining to electricity. Most of the small towns have electrical companies in operation, but there is some municipal development of street railway operation. The city of Tokio has taken over all its street car systems and combined them in one system. There are a great number of water powers in Japan, and they are being extensively developed. In Hokkaido Island, to the north of Japan, a plant has been installed for the large steel works and gun factory, which Mr. Siddeley went to start up. His company installed a 3,000-KW. steam plant there

with separate motors for operating each of the tools, 30 in all.

Speaking of Canada, Mr. Siddeley said, "I think that British Columbia, especially in the neighbourhood of Vancouver, will be an enormous centre for electrical enterprise." In Victoria his company installed an automatic booster.

A Canadian Booklet.

Last year our contemporary, *Canada*, sent out an expert salesman, Mr. Herbert J. Rodgers, as Trade Commissioner to inquire thoroughly into the conditions governing British trade with the Dominion. His observations were published in that journal in a series of articles, and they have now been produced in the form of a handy shilling booklet. The object of the handbook is to enable the British manufacturer to determine whether his goods are suitable for the Canadian market, how best he can introduce them, and what his rivals are doing. From a perusal that we have made of the contents, we can imagine that it might be interestedly and profitably read by anyone thinking of studying the market in person, but naturally it is quite impossible for a general salesman to appreciate the many special points of a more or less technical description that inevitably arise when he touches upon a market with which he has no direct familiarity. It is therefore not surprising to find that of electrical information relating to the market there is very little indeed, and what there is is hardly to be treated as a reliable guide. When the articles were appearing in our contemporary's pages, we "lifted" the electrical remarks and published them in our "Business Notes," and some of the statements were traversed very severely by an electrical correspondent who knew the Canadian electrical market intimately. Mr. Rodgers says: "The main demand for electrical goods is, of course, in traction (street cars, &c.), motive power for plants, &c., telephones and lighting"—the mere method of expressing himself is no more than one would expect—"In every one of these there is enormous development going on, and inasmuch *as there is comparatively little variation in electrical appliances and accessories in use in Canada from similar items in England*, the British maker should find a wider trade with ordinary attention to the market." It was the italicised words for which the Trade Commissioner was taken to task, our own contributor pointing out that the things in demand in Canada were not those sold every day in England. He showed what things are called for, and why, in our issue of April 23rd, 1909, page 668. If we turn over to the author's "Machinery" section we find observations which might appropriately have been substituted for what he says concerning electrical appliances and accessories: "The whole machinery problem is one that any reputable English firm should find it worth while to study on the spot, *find out local requirements*—Canada is a continent, not a county—and follow up the results of such investigation with an energetic campaign. The booklet contains many points which would, no doubt, interest the would-be traveller personally.

This all-important question of knowing the exact requirements of the market before you attempt to cater for it is very strongly brought out by Mr. F. A. McKenzie, who is now in Canada as a Special Commissioner for the *Daily Mail*, and is writing a series of notes on the "Land of Opportunity" in that newspaper. He tells a story of lines of trade that have been lost, because in a field where British firms thought they were secure, foreign competitors entered with the same sort of thing with a small difference which made it more acceptable to the Canadian purchaser. The "new thing" "took on," and when the British makers were urged to lay themselves out to retain the market by meeting the new requirements they refused, because they "were doing very well with things as they were." That particular market is now lost to the firm in question, purely as the result of that one act of refusing to move or be moved out of the satisfied rut in which they had got fixed. The special line was not in any way connected with electricity, but the case may be cited as one more instance of the imperative necessity that exists for studying closely and continuously the particular needs of a market, and offering for sale what is actually required, not what we would like to sell. If what we are already making fits the case, let us push it for all we are worth; if by a little modification it may be made more suitable, make the modifications for that market—was it in South Africa that a particular article would not sell until, under the advice of one who knew the whims and fancies of the people, it was embellished with a pretty little red label, and then it sold like wildfire? If what we make is unsuitable, either with or without modification, there are new lines that we can take up and fit in with our other manufacturing operations if we will.

American Exports.

Last week we referred to the American electrical export figures, and showed that the total of these exports for the year 1906-7 was 17¼ million dollars. It is amusing to find one of our contemporaries taking "a glance" through these figures, and saying, "our electrical demands from the United States are rapidly diminishing, being of the order of 17 million dollars in 1906-7, 15 millions in 1907-8, and 12½ millions in 1908-9, so that if these figures be indicative of our reliance on home products they are gratifying. But it is more than probable that they are caused by the general slump in our home trade." "It is more than probable" that our contemporary is a little out of it, seeing that the figures relate to the exports to all other countries as well as to the United Kingdom. The United Kingdom took 1½ millions in instruments and less than 1¼ millions in heavy electrical machinery in 1906-7, both of these sets of figures falling very considerably in the two following years.

Our contemporary will now admit that this country depends less upon the foreign manufacturer than it thought to be the case—or does it believe that, if our general home-trade revives, the American electrical exports to this country will go up by leaps and bounds? We do not believe they will do anything of the kind.

Tours Abroad.

Several years ago the Institution of Electrical Engineers arranged a series of tours in foreign countries where electrical engineering developments had taken place, which it was desirable, from whatever point of view one regarded them, for English electrical men to see. These visits were immensely enjoyed by all who took part in them, were very impressive and educative from the technical point of view, and confirmed the opinion that in certain directions Continental designers and manufacturers were in advance of British. The spirit of comradeship between electrical men in England, Switzerland, Germany, Italy, and the States, was notably fostered, and probably from our foreign friends we picked up a point or two which have leavened our own methods in some respects. All that is to the good, and we revere the memory of the lamented secretary of those days, who wore himself out in the interests of the Institution which he so faithfully served up to the hour of his death. We will not speculate upon whether orders went abroad which would have stayed at home had there been no visits—probably they did, but against that we set the gain already mentioned, together with the advantage of international fraternisation for all engineers. Those were not tours in search of business, they were tours in search of knowledge and instruction. We had all heard of things that were being done, and we wanted to see them for ourselves. Nowadays what we require is tours of quite another kind—tours in search of information regarding the openings that other countries are able to present for the British manufacturer to sell electrical machinery and apparatus. Maybe that in commerce we are all so much in rivalry with our fellows that we shall prefer to make our studies individually—of course, generally speaking, we do not make a practice of letting makers in the same line of goods know from whom we are seeking orders. Yet is it not worth while considering whether we might not nationally do better than we are doing if half-a-dozen, or a dozen, or a score or more, electrical men capable of exercising a sound and safe judgment and discrimination were to make a visit of examination to some of the markets that have been less cultivated by the British electrical manufacturer than they ought to be? We were advised by a Consular authority in Spain a few years ago to get a representative British electrical organisation to study the general position and prospects of that country. We supported the suggestion, but we have no

organisation that could do it. The Institution of Electrical Engineers was named by the adviser, the National Electrical Manufacturers' Association was named by us, but nothing conjointly was done, though we have heard of one and another electrical exploiter who has since been personally the other side of the Pyrenees. Does the suggestion apply more forcibly to Spain than to a number of other countries that might be mentioned? Whatever benefit came to British electrical manufacturers nationally as a result, would come to them individually. Is there no good in the idea? Chambers of Commerce from other countries come here and our own Chambers repay the visits; but the electrical elements in these Chambers is, as a rule, either very small or it does not exist at all. We observe that the City of London International Commercial Association is going for a tour in France next month, visiting Paris, Rouen, Havre, Lille and Dunkirk, as it did the South of France in 1907. This is very good from a general commercial point of view, but is there any electrical element in it? The electrical trade, *that* is our concern, much as we rejoice at all general development. Individual enterprise in extending trade abroad there must be—that is indispensable whether we go in companies or not to get a general intimate idea of electrical possibilities; but the conjoint effort ought to improve the chances of the individual traveller.

Porto Rico's Future Electrically.

Our American namesake alludes to a Bulletin recently published by the American Census Department, regarding the electrical industrial position in Porto Rico. It appears that the electrical enterprises for the island are not yet extensive, but there is great promise for the future. Turbine and water wheel electric plants are operated by railway, light and power companies, the total capital expended upon these undertakings, excluding the telegraph system, being, roughly, half-a-million sterling. Only six towns are lighted by electricity, and the total arc lamps numbered 469, the incandescents 34,519, and the motors 61. Three electric street railways are operating and one is constructing. Electric traction is stated to be the most important electrical branch in the island.

"The operation is on a small scale as yet, compared with the progress in the United States, but the density of population, which is greater there than in the majority of the States, warrants the belief that the increase during the current five years will be much greater than for the preceding period. The output in current of the electrical generators reported for 1907 was three times as great as for 1902."

Foreign Trade in August.

As we go to Press the trade returns for the month of August are being discussed in the newspapers. The improvement in both imports and exports continues. The exports are better by 5·8 per cent. than in the corresponding month of 1908, this increase valuing at £1,772,024, making a total of £32,114,700. Electrical goods and apparatus imported show a decrease in value of £27,846, and there is a small decrease (£3,172) in exports of the same class. For the eight months of the year, however, the exports of electrical goods and apparatus other than machinery and telegraph and telephone wire, are better by £239,932. The chief improvement in exports occurs in cotton and woollen goods, and this leads one to hope that before long these trades will begin to feel a substantial benefit, leading them to modernise their mills electrically, and in some places to complete the electrical equipments that they set out upon when the late boom was too far advanced for them to get the full benefit from them. As the *Times* says, the exports have not yet "wiped out" the serious reduction shown during the first five months of the year, and they show a decrease of 3·7 per cent. In March, April and May the decreases were heavy compared with the corresponding months in 1908 and 1907, but "the year 1907 was a year of abnormally high figures, following two other very good years, and it is not surprising that during 1908, and a considerable part of 1909, there were reductions in our trade with foreign countries and British possessions, as a whole." In June the tide turned, and July and August both reflected improvement. The *Times* comments on the slight decreases recorded in iron and steel manufactures and machinery, thus:—"The sluggishness of these very important classes of goods appears to indicate that although the period of depression has come to an end, it cannot be said that the period of revival has actually begun." We believe that in following months it will be possible to trace the effects of revival in these items as well.

Continental Offices.

"To carry the war into the enemy's camp," is an expression often used by those ambitious to get into Continental countries competing with the foreign manufacturer on his own ground. We meet men who are convinced that tariffs notwithstanding, it would not be a Herculean task to sell British electrical machinery and other manufactures in Germany at competitive yet profitable prices. Others are of opinion that to go there to manufacture is more hopeful, but there does not appear to be much capital about for this class of venture, nor are we particularly desirous of helping in the establishment of electrical factories in other countries to give employment to the peoples of those parts. But the effort to sell electrical goods on the Continent is worth the making, and a Continental office or two is necessary if one is to build up and maintain a business connection there. We are interested to learn from a Coventry firm of machine-tool makers (Messrs. Alfred Herbert, Ltd.) that they are opening an office in Berlin next week in order to be able to deal promptly with inquiries received from Germany and Austria-Hungary for their line of labour-saving machine tools. A practical man will be on the spot able to talk intelligently and convincingly regarding these particular manufactures. We shall be glad later to hear what measure of success attends this new step, though we have little doubt as to a good reward being gained. It is for British electrical manufacturers of specialised lines to see how far it would pay them to go and do likewise.

(*To be continued.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Curious Lamp Failure.

The accompanying photograph shows an extraordinary accident to an electric lamp bulb in use in Pinkston Tramway Power Station, Glasgow. It is an ordinary 100-volt carbon-filament lamp, and burned quite normally for weeks on one of the main engines. One morning it was found in the condition shown in the photograph. The glass, from some

cause which cannot easily be determined, had become momentarily plastic, and it was dinted like an india-rubber ball. The bulb was not broken in any way, and externally was quite clean. Internally it was coated with a deposit of soot which rendered it quite opaque. The lamp was subsequently broken and the filament found to be intact.

N. B.

What is an Electrician?

The word electrician is a term that we hear very often used, and I should be very pleased if you would kindly insert this letter so as to obtain other readers' views on the subject, as I find the expression is very often used by, and to apply to, men in all classes of positions in connection with the electrical trade, *i.e.*, wiremen, arc lamp trimmers, motor attendants, electrical fitters, &c. In fact, it appears as if

anyone connected with plant maintenance may style himself an electrician, whatever that may be. I cannot find where the term is recognised by any reliable authority. For instance, take the City and Guilds of London Institute and examine their programme, and we find that they have no courses of instruction for anyone styling himself electrician. Instead, they provide for two district callings, namely, electrical engineering for those who aspire to become electrical engineers; and, secondly, electric wireman's work, for those who desire to become wiremen, and the second year's work on the same subject for those whose ambition is to take charge.

1. An electrical engineer is one who has a thorough all-round knowledge of the trade, or should have.

2. A wireman is one who understands and is capable of the following, or should be:—

(Extracts taken from the City and Guilds programme, first and second year's work.)

Electrical Machinery, C.C. and A.C. Motors.—Principles of action; the practical importance of the back E.M.F. and conditions of producing it; field windings and their connections with the armature and the supply circuit, causes of breakdowns and their remedies.

C.C. and A.C. Dynamos.—Their installation and running; regulation by resistance in the field circuit; principles involved; testing of dynamos and motors for insulation; temperature tests under load; testing for faults.

Starting Switches.—No-voltage and overload release devices; principles involved.

Secondary Batteries.—Their installation and practical treatment; precautions in charging and discharging and testing same.

Magnetic Properties of Materials.—The magnetisation of iron by electric currents; permeability; the law of ampere-turns; electromagnets.

Electrical Properties of Materials.—Conditions which hasten deterioration.

Electrical Measurements.—Application of Ohm's law; methods of measuring resistance, E.M.F. and current.

Calculations of contact areas for switches and cross-sectional area for bus-bars, cables, &c.

Joints on cables up to ½ sq. in. sectional area; jointing and connecting of lead-covered cables, including V.R. or paper-insulated concentrics; the making of vulcanised joints.

In addition he is expected to have acquired sufficient knowledge of mechanical drawing and sufficient skill in hand sketching to enable him to make a dimensioned sketch roughly to scale, which would be understood in the works or drawing office.

Therefore from the foregoing I take it that the man who should have charge of plant running and maintenance, failing an electrical engineer, is the wireman, and not one who terms himself an electrician; yet often if a qualified wireman applies for a position in charge of plant, he is ignored because they want an electrician.

I should be very pleased to see other readers' views on the subject as to what constitutes an electrician. The City and Guilds do not appear to recognise this class of workman. The Electrical Contractors' Association only recognise the following: labourers, assistant wiremen, wiremen and charge hands (this coincides with the City and Guilds recognised classes of men). The Standard Electrical Dictionary does not mention the term.

Alpha.

[Our view is that a man who has qualified in the two years' course of training in electric wireman's work, and has acquired some experience in running electrical machinery, is quite correctly styled an "electrician."—Eds. E.R.]

Unemployment.

Much has been written from time to time regarding this subject. I wonder if the following concrete case will interest any of your readers.

I am 28 years of age, with varied experience at home and abroad on central station erection, shift and distribution work, and for this have good testimonials, &c.; yet, since February last, when I finished up as charge erector at several well-known stations, I have been unable to hear of anything. I have advertised, but it's almost waste of money; and as to answering advertisements—well, it's more than disheartening. The odds seem to be at least 100 to 1 whether your letter is even opened. The result is, September is here, the outlook is blank, and I cannot afford to idle the winter away. The only other alternative seems to be emigration. I am offered farm work in Canada, and, seemingly, shall be forced to take it on.

When I look round and see how some of the high and responsible positions are filled, it makes my blood boil to think that I (also others), an educated and essentially practical man, with good capabilities, am compelled to emigrate. There is something radically wrong when England forces men who would be valuable to her to leave her shores for pastures new. Possibly, if I cared to help to lower the tone of the profession by accepting station and plant work at 25s. a week, I might get something; but, as I always try to play "cricket," I don't intend to try. Farm work would be more creditable.

Omar.

September 6th, 1909.

Lighting Circuit with Earth Return.

Is it practicable to change from an existing electric lighting circuit which has an earth return and is of 110 volts 80 amperes D.C., extending between a private generating station and a private house ½ mile away, to A.C., and would there be any bad effects from the change-over?

The existing D.C. arrangement has run for 15 years with an earth return without giving any trouble, but the generating station is now being converted to A.C., and the current transformed down from three-phase 3,000-volt to single-phase 110-volt for this particular service. The location is a country village.

Puzzled.

September 4th, 1909.

[Earth returns for currents of this magnitude are rarely met with, though quite practicable in country districts, where there are no water pipes, &c., likely to be injured; but, with direct current, one would expect the earth plates to require renewal at rather frequent intervals. With alternating current this trouble would be reduced to a minimum, and the only consideration likely to cause annoyance would be that of interference with the Postmaster-General's property, particularly with telephones; even this, at 50 cycles per second, should not greatly affect private telephone circuits, but the P.M.G. is very jealous of his rights.—Eds. E.R.]

Electric Miners' Lamps.

I was pleased to see that my successor in charge of the electric miners' lamp installation at Fence Houses has contributed to this discussion.

Referring to his correction of my statement as to the proprietary of the colliery in question, I must point out to him that the Lambton group constitutes the Durham group, Lambton being the family name of Lord Durham. The Joicey group were interested in the Lambton, or Durham, group, hence my term Durham-Joicey group. The collieries under the joint control number about 16.

In his further correction he states that the Ediswan bulbs were ultimately found the more successful. This is welcome news. I can only repeat such was not my experience, which extended over 12 months and was gathered from three separate collieries.

It would add to the interest in this discussion if Mr. Turquand would communicate some actual results of his experience with the Ediswan bulbs, giving weekly figures over a reasonable period, and also stating at what collieries he has obtained such results. I should also like to hear of any successful working results from the adoption of the gas-detecting apparatus mentioned in his letter. His figures giving the working costs of the lamp he has himself designed, as also estimated by himself, appear to be quite impossible, and if such economical results could be actually attained in practice, there would be no difficulty in securing its adoption in almost every colliery in the country. The estimated working cost is given for installations of 2,000 lamps as 1·2d. per lamp per week.

In the first place, where are the collieries that would require this amount? If Mr. Turquand proposes to supply many collieries from one station, then labour charges alone

would amount to the figure he quotes as the total working costs, including interest on capital. Bulbs averaging 800 hours' life, and costing only 8d. each, would mean an expenditure of ½d. per lamp per week; while an allowance of 1d. per lamp per week, for such items as renewal of battery plates, damaged cases, broken glasses, flexible connectors, worn-out and broken lugs, complete smashes due to falls, split ebonite cases, &c., including distilled water, sulphuric acid, lead rivets, and general repairing material—would be an exceptionally small cost, even if possible. An installation of this magnitude would involve an outlay to the colliery proprietors of £1,000.

Assuming that batteries would be charged in four sections—it would be possible to charge them in three—to meet the requirements of the different shifts at the colliery, a 5-KW. dynamo would be required to run almost continuously throughout the week. This item, even at a colliery, must be considered when dealing with working costs.

The total energy required to charge the batteries would amount to 400 B.T.U. per week, which, including oil, waste and separate attendance, would amount to ½d. per unit. This item increases the cost per lamp per week by ·1d.

Again, some allowance for capital expenditure must be included, which, at 5 per cent. on £1,000, adds a further ·1d. per lamp per week. An item involving ·1d. per lamp per week would be found in depreciation, which again, at 5 per cent. of capital value, would cost this figure. This would allow the value of the plant to be written off in 20 years, and must not be on any account omitted.

Here, then, we have a modest estimate of the working costs of electric miners' lamps—as those who have been concerned with costs will admit—running into a total of 3d. per lamp per week, and, in my opinion, it would be more prudent finance to increase this amount to 4d.; as is well known, many things crop up in practice which are never thought of in estimates. Besides these costs, we should have to make some provision against breakdowns.

Now, nothing is said of profits. Are the collieries to make their own lamps and batteries, or are they to be purchased from a company? In any case, it is not going to be done without further capital, which must add to the cost one way or another.

Giraldus Jones.

Birmingham, *September 6th*, 1909.

The New Theory of Electricity.

May an electrical engineer who has made a very close study of the principles of electricity, and who has been very actively engaged in its practice for over 35 years, ask the advocates of the new theory of electricity to give us some more proof than they have hitherto offered? I think everyone who has studied the subject will have noticed two important gaps in the chain of evidence. The writer of your very appreciative article in this week's issue of the ELECTRICAL REVIEW notices one, the complete absence of any knowledge of the positive electron. This gap may fairly be taken as one that could be filled in later on. There is another and far more serious gap, however, viz., the proof that the negatively electrified corpuscle and negative electricity are one. In an article that was written by Prof. Fleming, seven years ago, he deals with the matter thus:—"At the present moment we have no evidence that we can separate the electron charge from the corpuscle itself. If this is the case, then the corpuscles taken together constitute for all practical purposes negative electricity. . . . . For this reason it is sometimes usual to speak of the corpuscle carrying its charge of one electron of negative electricity simply as an electron, and to drop all distinction between electric charge and the vehicle in or on which it is conveyed." Apparently upon this, which on the face of it is a pure assumption, have been built up all the somewhat startling theories as to electric currents, &c., that have followed. Surely the acceptance of a scientific theory requires more substantial proof than this. If we take the case of heat, for instance, a heated body flying through space is not heat; why should we be asked to say that an electrified body flying through space is electricity?

A careful study of all that has been written on the subject will, I think, bring any impartial thinker to the conclusion that nothing which has been stated by the advocates of the corpuscular theory of electricity is inconsistent with a wave theory of electricity.

We have a wave theory for heat and light, which has been accepted for a very great many years. Electricity is as easily converted into heat or light, and the converse, as heat is converted into light, and the converse; why should not the wave theory of heat and light be extended to electricity?

I join heartily in the appreciative references in your article to the splendid work which has been done, particularly by Prof. Rutherford, but one cannot help making two observations upon them. When dealing with such very minute bodies, such very minute quantities, as those who have been working with radium have handled, can they be quite sure that their measurements are correct; and also, that they have eliminated all sources of error, not only in measurement, but that bear upon the important question of the explanation of the phenomena? The other observation is, while one can sincerely admire the skill with which, according to his own account, Prof. Rutherford has handled the *a* particle, one would again remark that an electrically-charged particle is not electricity. A procession of electrically-charged particles would imitate an electric current, but I think we should ask for further evidence that they actually constitute an electric current, and that the phenomena are the same as those produced by the ordinary working currents.

I think one reason for the divergence which I venture to think exists between the views of electricity held by what are called advanced thinkers, such as the present President of the British Association and his followers, and those held by practical electrical engineers, is that the advanced thinkers have come to the study of the question from the induction coil, and the Crookes's tube; the theory has been built up directly from a fact, which Crookes noted a good many years ago, that the cathode rays carried electricity; while practical electrical engineers have approached the study from comparatively low-tension electricity. With the advance of electrical transmission through long distances, the practical men are getting on to the ground of the advanced thinkers, and the work that is being done upon the corona, observed round high-tension transmission lines, ought to be of great value in helping to solve the question "What is electricity?"

I do not know whether I am correct in supposing that Sir Joseph Thomson, Sir Oliver Lodge, and those who work with them, will consider that practical electrical engineers have no concern with advanced theories, except to accept them when offered. If so, I would remind those gentlemen that the practical engineer must, of necessity, be the final and absolute judge of their work. The theory of to-day, if correct, may be the working hypothesis of to-morrow. The day has long gone by when the practical engineer worked from hand to mouth. The work which Sir Oliver Lodge and others have done in educating the engineers who have come into practical work during the last 25 years, though it may not always have been as wise as some of us would have liked, has produced one effect, viz., that the modern engineer is also a scientist in the fullest sense of the term. He has not the time to investigate problems in the manner they are investigated in a laboratory, but he is constantly thinking backwards, referring every new phenomenon which comes under his notice, and they are constantly cropping up in practical work, right back to first principles. It should also be remembered that every large firm has now its laboratory, in which probably quite as valuable work in demanding its secrets from nature is done, as in some of the college laboratories.

I trust that the remarks that I have made will be taken in the sense in which they are written. I do not know if Sir Joseph Thomson or Sir Oliver Lodge sees the ELECTRICAL REVIEW. If not, I trust that some friend will point out to them the fact that practical engineers look askance at their theory, and ask that the two gaps in the chain of evidence, and particularly the one connecting the corpuscle with electricity, shall be filled.

Sydney F. Walker.

Bath, *September 6th*, 1909.

[The answer to Mr. Walker's question regarding the separate existence of the corpuscle, or unit quantity of nega-

tive electricity, is given in Sir J. J. Thomson's address. The whole of the mass of the moving corpuscle, it has been shown, is due to its charge; the conclusion seems unavoidable that the corpuscle *is* the charge—unless our correspondent is prepared to dispute the accuracy of the experimental data. There is no suggestion that the α particle is electricity; it appears to be an atom of helium, carrying a positive charge.—Eds. E.R.]

Naval Voltages.

A few lines in further reply to "The Writer of the Article." The summary of apparatus installed in a warship, as given in my previous letter, was a general and not a specific one, and would roughly apply to as far back as the *King Edward VII* class, which earlier boats can hardly be classed "the very latest type." My letter does not describe the electrical installation as it may be expected in a few years' time, but as it is, and, generally speaking, has been for the past six years. 100-volt ships are a long way in the majority, not 80, which latter are rapidly becoming the exceptions. Personally, I should think anyone wishing to get an idea of naval electrical practice, would not choose much other than a fairly modern ship to look over. Ships prior to *King Edward VII* class carried little electrical apparatus, in comparison with that class, and later. Wireless telegraphy was not in use when the 80 volts ruled as standard, but, as stated in my previous letter, was taken back to 80-volt ships.

In conclusion, I am not aware of having used personal invective. Further, I have no desire to parade my knowledge, but deem it necessary to correct an article written in evident ignorance of the subject, especially when such article makes light of the ordinary intelligence possessed by those professionally engaged in naval electrical matters.

H. P. B.

Long-range Electric Alarm.

Can you, or any of your readers, inform us if there is an electric alarm on the market capable of being heard over a radius of 1 mile? The apparatus would be fixed on the exterior of a building in the centre of a town.

Bowden, Higlett & Co.

Guildford, *September 6th*, 1909.

X-Ray Tubes.

Mr. Bastian's letter in your issue of August 27th is surely written under some misapprehension, because I have never heard it suggested that the vacuum in a Geissler tube would change in any way in the absence of any leakage through the walls of the tube.

I have often sought some explanation of the change in vacuum in an X-ray tube, and shall be glad if Mr. Bastian, or any of your readers, can suggest something less abstruse than that it is due to "ionising action," which latter is in itself not too well understood.

I may not specifically describe the apparatus referred to in my last letter, but I may say here that it is designed to contain a liquid in a sealed-glass vessel, through which platinum leading-in wires have been used carrying very small currents—considerably under 1 ampere.

My trouble is that the liquid is very apt to leak out around these leading-in wires, and I cannot understand why there is apparently more difficulty in making these seals than there is in making the seals of an incandescent lamp. The apparatus has been made by skilled glass-blowers, and the trouble certainly cannot be ascribed to careless workmanship.

Jacey.

A Supply Company's Enterprise.

I beg to bring to your notice, and to the notice of the electrical contracting trade, the unfair methods that are being made use of by the County of London Electric Supply Co., Ltd., to cut up the electrical contractors in their district. They are not only supplying transformers, but their agents are now engaged in canvassing private people and shopkeepers with fittings and Osram lamps. All that is left for the contractor is a job worth a few shillings for fixing, &c. How long this will be left for him is an open question, for now the thin end of the wedge is inserted I should not be surprised to learn any day that they had started a wiring branch. Their mode of business is especially hard upon small contractors, men who, by their persistent canvassing, have secured hundreds of customers for this company. Another flagrant case against them is that during last autumn, when metallic-filament lamps and transformers were "going great guns," and contractors were beginning to see plenty of business ahead, this company sent a circular letter to their customers advising them not to alter their mode of lighting as they had proved it was no saving (poor contractor). However, finding it did not stem the tide much, in a couple of months they performed a wonderful feat, turning a somersault and coming down on the side of the M.F. lamp and the transformer, canvassing the very clients whom they had tried to turn against them, and pushing their transformers (on the hire system) for all their worth. Now, Sir, what can be done when a large company tries on such dirty tricks? Verily, it looks rough on tallymen and hire-furnish people if this company are set upon improving (?) business. I should be pleased to learn the opinion of other contractors who find, like me, that they are being hit by this unfair competition.

Putney Contractor.

Technical Classes in the Daytime.

We desire to advise those shift engineers who have written to you on the subject of day classes, and also those who have not written, but who nevertheless have felt the same need, that our Correspondence Courses were specially drawn up to meet their requirements. We have never claimed that tuition by correspondence is better than oral tuition given by the same teachers, nor do we claim that a student, after taking one or more of our courses, will be able to command the salary of a managing director, but we have gratifying evidence from our students that our lessons have been of real service to them in their every-day work. There are numbers of people engaged in the various branches of electrical engineering who cannot attend either day or evening classes, and to all such we shall be glad to send particulars of our Correspondence Courses on receipt of name and address.

The British Correspondence School of Electrical Engineering.

London, W.C., *September 7th*, 1909.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

A New Electric Flasher.

An electric flasher of a new type has recently been brought to our notice by the inventor and patentee, Mr. C. H. Jukes-Brown, of 76, Weston Road, Strood. The arrangement is exceedingly simple, and its mode of operation can be gathered by reference to the diagram (fig. 1). It consists essentially of a zinc tube A, surrounded by a resistance coil B, which in operation alternately heats and cools the tube, the movement of which (due to expansion and contraction) is communicated to a bell-crank lever having at one end jaws carrying adjustable screws, L, C. Screw L has an insulated point, while screw C is uninsulated.

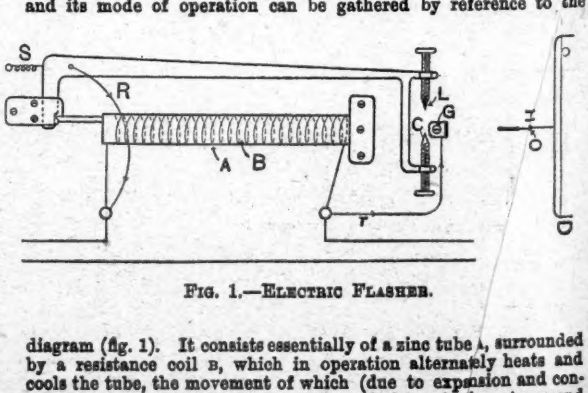


Fig. 1.—Electric Flasher.

Between the screw points is suspended a contact arm H, pivoted at O (see end view), and resting on support G. This contact maker carries a small ball race, and, of course, lies in a plane at right angles to the diagram, and central with the two screws.

In operation the oscillatory movement of the lever swings the contact arm H to just beyond the middle position, when, the balance being upset, it tilts over to the opposite contact, and *vice versa*. The making and breaking of these contacts successively completes circuits *via* the resistance (when the lights go out), or *via* screw C, lever and wire B direct to the lamps for lighting them. The to-and-fro motion of the ball gives a quick make and break, and tends to keep pressure on the contacts. By adjusting the distance between the screw points the flashing intervals can be varied from a few seconds to as many minutes. The device is only 9 in. long over all, and the inventor suggests that its operation alone would prove an attraction for shop windows.

A Petrol-Electric Riveter.

Somewhat of a novelty in the way of riveting machinery is the Ryerson internal-combustion riveter, a self-contained apparatus designed for the use of gas or liquid fuel. The essential parts are a cylinder and piston, the latter coupled by toggle levers to the head of the die; also a small electric motor mounted on the cylinder, which drives a little carburetting pump. To start

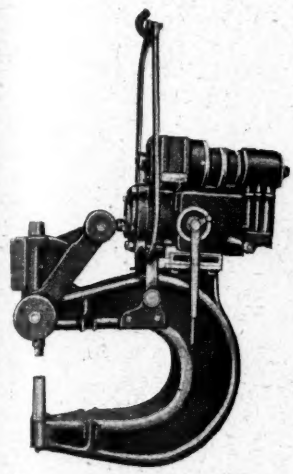


Fig. 2.—The Ryerson Riveter.

the machine the operating lever is thrown over, switching in the motor, which pumps a carburetted charge into the cylinder, forcing the piston forward and causing the die head to descend on to the rivet. This arrests the motion of the piston, causing the pressure to rise in the cylinder, and operates an automatic device which cuts out the motor and at the same time ignites the cylinder charge, thus closing the rivet head. The reversal of the operating lever opens an exhaust valve, allowing the burnt gases to escape, the piston being returned to the head of the cylinder by means of a spring in the toggle mechanism.

The machine is shown in fig. 2; it is very portable, and its action is so rapid that rivets are driven at their full heat.

An auxiliary control lever is provided, by means of which the cylinder charge and resultant pressure on the die can be regulated to suit the condition of the rivet, thus doing away with the necessity for uniform heating of the rivets.

The machine will drive 4,000 ¾-in. rivets per gallon of petrol.

Auto-Transformer Switch.

We have received particulars of their automatic auto-transformer switch from Messrs. D. Burr & Son, 85, Gracechurch Street, E.C.,

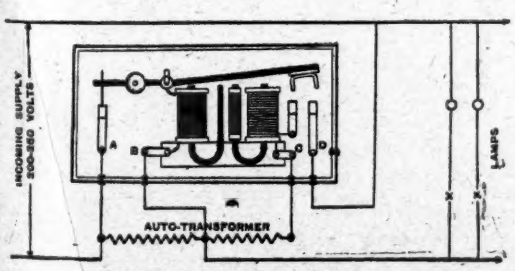


Fig. 3.—Burr Automatic Switch.

who are sole agents for this device. Its mode of action is shown by the diagram here given; when all lamps are off, the switch is opened by gravity, but when a lamp is switched on, the fine wire coil in circuit between A and B closes the switch, completing the circuit between C and D through the thick-wire coil, which holds the switch in. The lamps are then connected across half the transformer and the transformer across the mains, while the fine-wire coil is cut out.

The switch is built up on an oiled slate slab and mounted in a cast-iron case with glazed front, having porcelain bushes for the incoming leads. No special wiring arrangements are necessary with this apparatus, and it will operate when a single 16-watt metallic-filament lamp is switched on or off. The pressure drop over the series coil is negligible. The apparatus may be employed in conjunction with any of the auto-transformers at present on the market. It is claimed that the complete apparatus is very strong, and not likely to get out of order, while it is quite silent in working and absolutely reliable.

"Therol" Electric Water Heater.

Quite a new departure from the beaten track has been made by Messrs. Spagnoletti, Ltd., of Goldhawk Works, Goldhawk Road, W., in their electric water heater. When invited to inspect this device at the firm's new West-End showroom, we at first regarded the proposition to heat water with electricity as one of those luxuries reserved for the very rich, for the high specific heat of

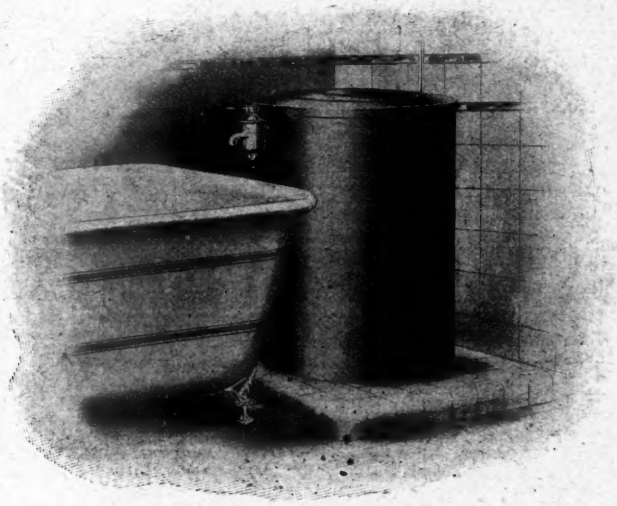


Fig. 4.—"Therol" Heater in Bathroom.

water entails a consumption of energy which, unless paid for at a very low rate, renders the cost exorbitant. Messrs. Spagnoletti's proposal, however, was found to provide a novel and original

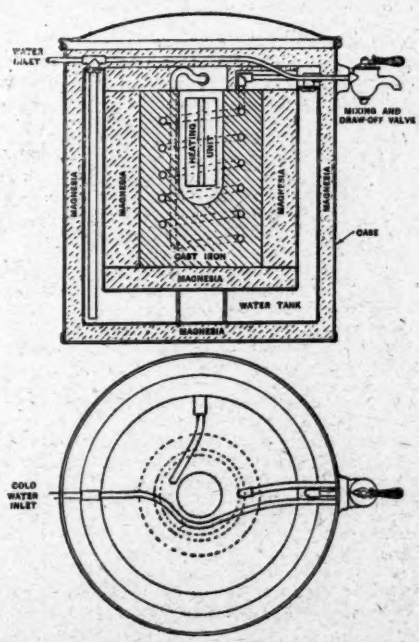


Fig. 5.—Sectional Elevation and Plan of "Therol" Heater.

solution of this difficulty. In brief, the apparatus consists of a block of cast-iron, which is heated up by a small but continuous electric current, thus storing energy. When the water is drawn off

it is heated while passing through the hot block, the temperature of the outflow being regulated by a special mixing valve.

Fig. 4 shows the complete apparatus installed in a bathroom, fig. 5 gives a plan and section of the heater, and fig. 6 shows the

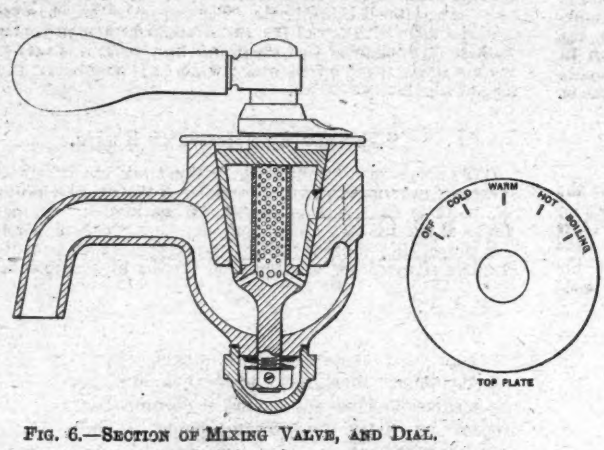


Fig. 6.—Section of Mixing Valve, and Dial.

construction of the mixing valve. The heater consists of a block of iron weighing about 2 cwt. (25-gallon size) cast round and upon a spiral tube, through which the water flows. A cavity in the top of the block receives the heating element, which absorbs 200 watts continuously, and the whole is surrounded by a thick layer of heat-insulating material, consisting mainly of magnesia. As an economiser, or "feed-water heater," an outer tank is provided, through which the water passes before entering the spiral, and this again is heavily lagged, while a polished copper case further retards radiation. When no water is drawn off, the temperature of the iron block may reach a maximum of 500° F., at which temperature the radiation losses equal the input; thus the block and heating element can never attain a dangerous temperature, and the outer case remains only moderately warm.

As water passing through the block necessarily becomes superheated steam, the mixing valve is an essential feature of the system, and the inventors found it necessary to devise a new pattern to satisfy their requirements. As shown, this consists of a hollow plug working in a conical seat, having three inlet apertures, connected respectively with the cold, the luke-warm (economiser) and the hot supply pipes. A pointer attached to the plug indicates five stages on a dial, from "off" to "boiling," which insensibly merge into one another, so that the temperature of the water is under perfect control. To ensure thorough mixture of the hot and cold supplies, a difficult but essential condition, the incoming streams are made to pass into a perforated tube and out again by other perforations in the apex of the plug, with the result that effectual mixture is obtained.

It is pointed out by the makers that as the input to this device is constant, the current need not be put through a meter, and it possesses a load factor of 100 per cent., so that central-station authorities should welcome it as a consuming device; further, it may be cut off during peak hours, without much affecting the hot-water supply, thus further cheapening the cost of generating the energy used, or it may be connected with a cooking circuit in such a way that current is diverted from one to the other as required, keeping the load constant. Suppliers, therefore, may justly be asked to charge even less than 1d. per unit thus used for heating water. As regards the performance of the apparatus from the consumer's point of view, the 200-watt size heats 25 gallons of water per day from 50° to 110° F., a larger quantity to a lower temperature, or a smaller quantity—9 gallons—to boiling point, according to the mixture effected by the valve. Greater quantities can be drawn off in one day, up to a maximum of about 37 gallons at 110° or 14 gallons at boiling point; but then the quantity available next day will be correspondingly reduced. The heater can give its full output after one day's continuous storage of energy. Owing to the system of lagging adopted, an efficiency of over 90 per cent. is claimed, with an average wait of 8 hours between draw-offs. The 200-watt (No. 1) Therol heater measures about 2 ft. each way; other sizes are in course of preparation.

On a schedule of £1 per kilowatt per quarter plus ½d. per unit—a scale actually quoted by a number of stations—the cost of energy would average 0·61d. per unit, or a total of £4 9s. 1d. per annum for 25 gallons of hot water per day, and this is said to be equivalent to gas at 3s. per thousand cubic feet. The "Therol" system is described in admirably compiled pamphlets issued by the company, and is worthy of the close attention of station managers.

D.G. Enclosed Arc Lamp.

Messrs. Drake & Gorham, Ltd., of 66, Victoria Street, S.W., are placing on the market a single-enclosure lamp of their own registered design, as shown in fig. 7. This is of the shuntless type, fitted with a patented device to prevent the lamp burning out of balance. The case of the lamp is dark green, with a polished copper spinning, giving the lamp a well-finished appearance. The case is also practically airtight, rendering it specially useful for dusty positions. It is well adapted for hiring-out purposes.

Fig. 7.—D.G. Enclosed Arc Lamp.

The firm's price list No. 148, a copy of which has been sent to us, gives details of several of the leading makes of flame lamps.

Spiral Self-Centring Chucks.

Mr. Charles Taylor, of Bartholomew Street, Birmingham, has sent us particulars of his patent chucks, which are usually made with three jaws. He has also brought out a four-jaw chuck, which we illustrate in fig. 8, and for which the following advantages are claimed as compared with the three-jaw pattern:—It is well adapted for holding square or octagon bars, castings, &c.; it is far

Fig. 8.—Taylor Patent Spiral Self-Centring Chuck with Four Jaws.

more efficient for very heavy work on round bars that are practically true, such as drawn steel, because the tendency of the bar under a heavy cut in a three-jaw chuck is to wedge itself sideways between the jaws, putting great stress upon them and loosening the grip. The four-jaw chuck is free from these objections, and has an equally firm initial grip.

A SIMPLE METHOD OF LOADING A TRANSFORMER.

Several methods of testing transformers under full load conditions, without the use of load resistances or the expenditure of the energy corresponding to the full-load output, are in use, but most of them involve the use of a second similar transformer, or at least of some form of auxiliary transformer. It is, however, possible, as is pointed out by Dr. Benischke in *E. & M.* for July 4th, to test a single transformer in this differential way without the use of auxiliary apparatus, provided that one of the windings can be split up into two approximately equal parts. This can be done in most transformers without trouble. If the two parts have exactly

equal numbers of turns, and are connected together at both ends in such a way that their induced voltages oppose one another, they will each set up the normal voltage, but no current will circulate in them. If, however, one number of turns is slightly in excess of the other, a current will circulate round the closed circuit, of sufficient amount to dissipate this excess voltage by combined resistance and inductive drop. The necessary excess of voltage required to cause the normal full load current to circulate can be readily obtained by winding a few additional turns on one of the limbs or on the yokes, or, if tappings are available, a few of the turns of one limb can be omitted.

The connections are shown diagrammatically in fig. 1. The number of auxiliary turns should be sufficient to give a voltage equal to the short-circuit voltage of the transformer, and then the correct full load current J_2 will circulate in the secondary. At the

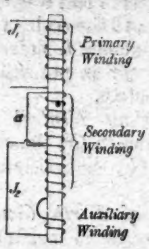


FIG. 1.

same time, since the normal supply voltage will be applied to the primary, the transformer will be working under normal flux conditions. The whole of the losses, and only the losses, are supplied through the primary, so that its current is, of course, low, and depends only on the amount of the losses in copper and iron, and on the leakage flux of the transformers. The conditions during the test are, therefore, not the normal full load ones, since the primary copper losses are practically those corresponding to the no load instead of the full load current. This detracts from the value of the method for temperature tests. The slight extra loss in the auxiliary turns is not usually appreciable. The method is applicable to both single-phase and multiphase transformers.

EARTHING THE "NEUTRAL" OF THREE-WIRE SYSTEMS.

[COMMUNICATED.]

THE question concerning the extent to which the middle wire of a three-wire system should be earthed has been much discussed, and very different opinions on the matter are still prevalent. There can be little doubt that the main should be earthed to some extent, but beyond this bare principle there are many alternatives and difficulties. The Board of Trade regulations in this country are that the middle wire of every three-wire system shall be earthed at the generating station and efficiently insulated over the rest of its length. As is shown below, either such earthing, or complete earthing, over the whole length of the main is necessary. If the earth at the generating station be through an appreciable resistance, as is advisable for reasons mentioned later, this earth should be the only one on the main, which should be carefully insulated at all other points. If, however, a very low resistance earth be preferred, then the main should be earthed throughout its length, a number of local earths being undesirable. A permanent very low resistance earth is open to objections, and below is mentioned a system of earthing which combines the advantages of "dead" earthing and of earthing through resistance, providing due care be taken to maintain the insulation of the neutral conductor.

The main object of earthing the neutral is to prevent the negative outer conductor from gradually assuming earth potential by electric osmosis, and so forcing the positive outer to 400 or 500 volts above earth. Not only would the insulation be unduly strained in the latter eventuality, but also the B. of T. regulation, that no part of a three-wire lighting system shall be more than 250 volts above earth, would be violated. It is, however, to be noted in passing that the St. Pancras three-wire system ran for about 13 years with an unearthed neutral to which no fire or accident of any sort was attributable. The B. of T. has since insisted on its regulations in the matter being observed in this, the only notable instance of their disregard of which the writer is aware.

The middle wire of a three-wire system should never be capable of other than intentional interruption—*i.e.*, a switch should be placed at the central station or sub-station to allow of the disconnecting of the neutral from earth for testing purposes, but it should be impossible for the middle wire circuit to be *opened* at any part of its length by fuses or cut-outs (though in certain cases these may be used and shunted by resistances which provide alternative paths on the operation of the fuse or circuit breaker). Further, the middle wires of various distributing sections of feeder should be thoroughly interconnected, the outer mains being isolated, section to section, in the usual way. The necessity for the observance of these rules will be readily understood. The middle wire of a three-wire system is a "balancing" conductor, and any interruption of its continuity will allow the pressure balance of the system to be disturbed unless (which rarely happens) the load on the two sides is equal. Though complete interruption of the middle wire or the occurrence of any very heavy current flow through it, such as would be caused by a fault on either of the outers, is undesirable on the above grounds, yet, allowing the heavy current to flow uninterruptedly till the fault is isolated, is liable to cause serious damage to the cable sheath and insulation near the point of entrance of the current. Hence the most satisfactory form of earth connection, where the middle wire is well insulated except at the station earthing point, is that shown in fig. 1. A suitable resistance, usually a bank of lamps in parallel, capable of carrying 10 to 15 amperes at the normal pressure between either outer and the neutral, is shunted across a fuse and switch as

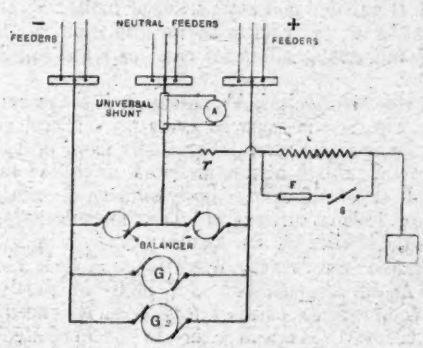


FIG. 1.

shown. The fuse F may, in such a case, be of 50 amperes capacity; the switch S is necessary to enable safe renewal of the fuse; an isolation switch should be provided for use when testing the neutral.

On the occurrence of a fault to earth on either outer, the current *via* F S rises, and, on its exceeding 50 amperes, F blows. The current flowing is then diverted *via* L, being thereby so reduced as to avert what might possibly have resulted in a station shut down and, at any rate, minimising the damage due to the fault. The damage done is, of course, considerably greater than it would be were the neutral entirely disconnected by the opening of F, but the advantage of retaining an earth connection, though of higher resistance than initially, is as follows: Directly the fault is removed by the opening of the fuse, cut-out or switch controlling it, the middle wire, being still earthed, will almost restore the normal potential and potential difference conditions. Otherwise, the entire disconnection of the neutral by the failure of F would permit the fu normal P.D. between the outers (400 to 500 volts) to exis between the sound "outer" and earth after the isolation of the fault and pending the replacement of F. By employing such a shunt path L, greater convenience of working is obtained. Intermittent faults constitute a great nuisance if their occurrence always involves the manual replacement of a switch before the middle wire can again become fully operative as a balancer. In the latter case, a heavier cut-out current would have to be allowed than in the arrangement of fig. 1, to prevent too frequent operation of the safety devices. Owing to the detrimental effect of heavy earth currents, this is a serious disadvantage. It may sometimes be advisable to insert quite a small resistance r in

series with both branches (L and F, S), but in general the "dead" earth *via* F, S is preferable for normal working, L being cut in automatically should the earth current assume values likely to damage the cable sheathing, &c., at the point of its inflow. The total resistance of the path *r*, F, S to E should not exceed 1½ to 2 ohms.

Where three-core concentric cables are employed, the outer being, of course, the neutral, it is usual to earth the station end of the middle wire as above, thoroughly maintaining its insulation at all other points. As an alternative it has been recommended to lay the cable with the outer conductor, covered with a lead sheath, to protect the copper from corrosion, but in direct electrical contact with the earth throughout its length (either literally, or in effect, by very frequent bonding).

The only objection to this course is the possibility of very heavy earth currents flowing on the occurrence of a fault on the outers, the heavy current damaging both the cables between which it flows, as well as any other cable near.

Where metal-sheathed cables are employed, they should be thoroughly inter-bonded, and bonded to water pipes at frequent intervals, so as to ensure metallic paths between all possible failures of insulation.

In this way the prolonged flow of small "fault" currents, capable of doing a deal of damage before their detection, is avoided. All faults, as a result of the metallic paths between them, develop into "clean," easily-localised breakdowns.

If the middle wire be insulated at all, it must be insulated thoroughly. Otherwise, owing to the earthing resistance *r* at the station (if any), and the resistance of the cable itself between the station and any particular fault, the potential of the neutral at faulty spots in its insulation will be above that of the earth, and hence earth currents will flow from them.

This statement only holds absolutely if the current in the middle wire is the same at every point; local equalising currents may set up potential gradients more or less accentuating or annulling the P.D. produced, as above; in general, a P.D. + or — will exist at every fault on the neutral main, and hence leakage currents will flow. These leakage currents, besides the electrolytic damage they cause, have been known to char, and even fire, the insulation, and melt the sheathing. Again, between two such faults in the "neutral" insulation, leakage currents may flow, the available P.D. being the net voltage drop in the intermediate length of cable, and the path frequently taken by the current being the sheaths of adjacent cables. Electrolytic, or worse, damage again ensues.

The extreme importance of thoroughly insulating the middle wire and of bonding all sheathed cables together and to earth at close intervals cannot be too strongly insisted on.

If the middle wire is not thoroughly insulated throughout, except at the station earthing point, it should be nowhere insulated, being laid bare and completely earthed; the objection to this course has been given.

A "short" or very heavy load on one side of a three-wire system tends to raise the pressure across the other side, and to minimise this tendency the third wire should have as low a resistance as possible. This is secured, with minimum expenditure of copper, by solidly inter-connecting the third wires of all distributing sections. This will in any case be performed, to some extent, by the earth itself, but a definite metallic connection gives the lowest resistance.

However low the current in the middle wire may appear at the station as read by A (fig. 1), this current varies from point to point along the neutral, and some sections of the conductor may temporarily carry very heavy equalising currents. For this reason no part of the neutral should be fitted with fuses, and it is a good plan, desirable also for other reasons, to fit all the consumers' switches and fuses on the outer mains, leaving the neutral quite clear, and hence always at, or only a few volts above, earth potential.

The middle wire insulation should be very frequently tested, and must be kept at a high value for the reasons already cited. Where this main is intentionally earthed at the station, there is a great tendency to ignore this precaution, all faults and the damage due to them being, in consequence, rapidly aggravated. Besides the deleterious effects of such faults as regards electrolysis and heating, they inevitably lead to attraction or repulsion of moisture by electric osmosis. In the first case, the fault is aggravated; in the second, weak spots in adjacent cables are fed with moisture. Concentric cables with neutral outers are, on developing a fault in the latter, protected from the rapid formation of faults to the inner cores by osmotic repulsion of moisture from the second conductor, which is usually made the positive "outer" for this reason.

Owing to the very variable magnitude of the "neutral" current, any ammeter used in this conductor, and such is highly desirable as indicating the state of balance of the system and the existence of faults on the outers, must be of wide range. To secure this conveniently and with reasonable accuracy throughout the scale, A should be a low current instrument shunted across a universal shunt of suitable ranges. The instrument is normally left across the lowest resistance shunt for safety.

Calculations regarding Neutral Earthing Conductors.—The chief of these concern (*a*) the cross-section to be allowed in the earth wires; (*b*) the resistance to be included in the earth circuit.

(*a*) *Cross-Section of Earth Conductors.*—This area is naturally proportioned to the maximum current that is likely to flow. Assuming this current on a liberal basis a section of not less than 0·00155 sq. in. (1 mm²) should be allowed per 10 amperes to be carried. This, the V.D.E. rule, corresponds to a current density of 6,460 amperes per sq. in., which is permissible only if the currents producing it are very intermittent and far above the normal. A minimum section of 0·0248 sq. in. (16 mm²) should be used in any case. On the above basis, this suffices for maximum earth currents up to 160 amperes. The earth wire must be protected against mechanical and chemical injury, and is connected to a suitable earth plate or grid of any recognised design, size and method of installation.

(*b*) *Resistance to be included in the Earth Circuit.*—The desirability of some resistance in the earthing circuit, even though, in some cases, it may cause greater damage at a fault than would occur were the middle wire completely disconnected by the blowing of the fuse, has already been explained. The magnitude of the allowable earthing resistance is not specified by the B. of T. regulations, but it is generally convenient to employ a permanent resistance *r* (fig. 1) of 1½ to 2 ohms in addition to any greater resistance which may be arranged to come into circuit on the blowing of a fuse (see fig. 1). The exact magnitude of the latter emergency resistance cannot be specified here. Rough proposals regarding it have already been made. The higher it is, the less will be the damage done at and near the fault after the opening of the direct earthing path F, S—the employment of a considerable resistance prevents any possibility of

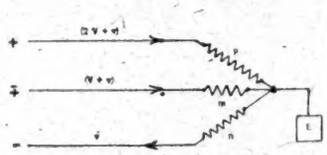


Fig. 2.

the damaged section being exposed to excessive currents before isolation or during localisation. Too high a resistance is, however, undesirable as detracting from the potential balancing effect of the neutral on the occurrence of a fault (see Table I). The design of the earthing resistance as regards temperature rise will seldom offer difficulties owing to the extreme intermittence of its service. As already mentioned, a bank of lamps grouped in parallel to carry 10-20 amperes at half the voltage between outers, forms a suitable and conveniently erected resistance. The fact that such a resistance automatically announces its coming into circuit, is of minor importance, other signals of a breakdown on an outer not being wanting.

The exact magnitude of the permanent resistance *r* in the earth circuit (fig. 1) is of considerable importance, since this determines by how much the neutral conductor exceeds earth potential under normal conditions. To determine the potentials of the various conductors of a three-wire system, the following method may be used. Referring to fig. 2, let—

p = resistance of faults from the positive outer to earth;
m = resistance of neutral earthing circuit;
n = resistance of faults from the negative outer to earth.

Further, let P.D. between outers = 2 v, and the potential of $n = v$. Then—

$$\left.\begin{aligned} c_p &= \frac{2\,v + v}{p} \\ c_m &= \frac{v + v}{m} \\ c_n &= \frac{v}{n} \end{aligned}\right\} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

and, by Kirchoff's network laws, the algebraic sum of these three currents must always equal zero, *i.e.*—

$$\frac{2\,v + v}{p} + \frac{v + v}{m} + \frac{v}{n} = 0, \quad \ldots \quad \ldots \quad (2)$$

a relationship which gives v; v, p, m and n being known.

As a particular example is assumed a three-wire system, with 460 volts between the outers, a fault of 40 ohms on the positive, and of 35 ohms on the negative outer (exceptional,

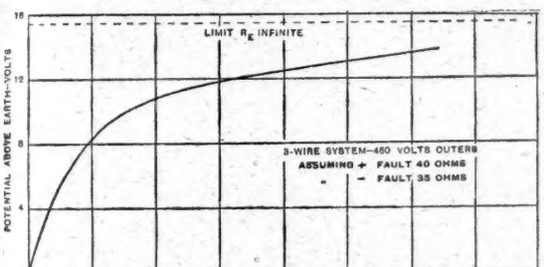

LIMIT R_E INFINITE
3-WIRE SYSTEM—460 VOLTS OUTERS
ASSUMING + FAULT 40 OHMS
" − " FAULT 35 OHMS
POTENTIAL ABOVE EARTH—VOLTS
EARTHING RESISTANCE − OHMS − R_E

FIG. 3.

of course). These faults are assumed constant, but the effective resistance in the earthing wire (= r + all contact and conductor resistances) is assumed to vary from 0 to 120 ohms, the potential and earth current distribution then being as in the following Table, these values being calculated from equations (1) and (2):—

Ohms.	v volts.	c amperes.	$(230 + v)$ volts.	c amperes.	$(460 + v)$ volts.	c_p amperes.
0	−230·00	6·56	0·00	0·810	+230·0	5·75
5	−226·76	6·48	+ 3·24	0·648	+233·5	5·82
10	−224·50	6·42	+ 5·50	0·550	+235·0	5·88
20	−222·00	6·345	+ 8·00	0·400	+237·0	5·92
30	−220·00	6·29	+10·00	0·330	+240·0	6·00
50	−218·80	6·25	+11·20	0·224	+241·0	6·02
70	−218·00	6·23	+12·00	0·171	+242·0	6·05
90	−217·30	6·20	+12·70	0·141	+242·7	6·07
120	−216·50	6·19	+13·50	0·1125	+243·5	6·09
∞	−214·50	6·13	+15·50	Nil	+245·5	6·13

It will be seen that the higher r the higher the potential of the neutral above earth, and hence the greater the tendency to electrolytic and other damage *via* faults on the neutral as already explained. Also, the higher r the greater the strain placed on the less faulty outer, and as a consequence the greater the leakage current from the latter. This usually results in rapid aggravation of the fault till it becomes worse than that on the other outer: the latter fault then becomes subject to increase, and the net result is a rapid extension of both faults if not immediately isolated.

This tendency is the greater, the greater r, hence it is that the latter is only a few ohms as a rule: 1½ to 2 ohms suffices for the permanent resistance (r + leads) and $\frac{v}{10}$ to $\frac{v}{20}$ ohms being suitable for the emergency resistance (fig. 1), where v = half voltage between outers.

In figs. 3 and 4 are represented graphically the results of the table. The remarks already made concerning the effect of rising r are excellently illustrated by these curves. The tendency of the potential of the neutral and the leakage currents from the outers to become asymptotic to lines representing their values when $r = \infty$, is clearly shown.

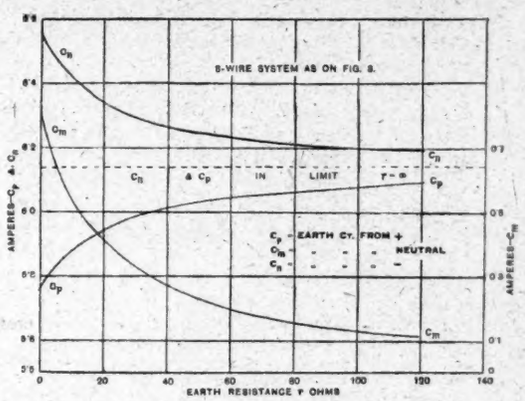


FIG. 4.

It is evident that, once r exceeds quite small values, increasing it further has little effect on the probable deleterious effects ensuing.

BUSINESS NOTES.

Busy Installation Contractors.—The following very imposing list of installations represents work which, with other smaller contracts, is at present engaging the attention of MESSRS. DUNCAN WATSON & CO.:—

King's College Hospital, Denmark Hill.—Wiring, underground mains, and fittings.
Maytham Hall, Kent, for Mr. H. J. Tennant, M.P.—Complete power scheme, with plant, electric lifts, wiring, electric bells, telephones, fittings and refrigerating plant.
Ovingdean Hall, Sussex.—Complete plant, direct-coupled petroleum set, wiring and fittings.
The Oaks, Sunningdale, Berks, for Mr. H. Batty-Smith.—Complete plant, wiring and fittings.
"Charters," Ascot.—Complete plant, including direct-coupled set, storage battery, wiring and fittings.
Sunningdale School, Sunningdale, Ascot.—Wiring and fittings, underground cables.
Ashurst Lodge, Sunninghill, Berks, for General Blundell.—Wiring, fittings and underground cable.
"Gilmuire," South Ascot, for Hon. Lady Ponsonby.—Electric light wiring, fittings and underground cable.
Large showroom and warehouse in London Wall.—Wiring, fittings and transformers.
Large block of mansions in Maida Vale.—Complete wiring.
Large manufacturing works in Northampton.—Electric installation in connection with suction gas plant, switchboard and accessories.
Manor House, Haslemere.—Reconstructing installation, wiring and fittings.
St. Mark's Church, Hamilton Terrace.—Re-wiring and fittings.
37, Hamilton Terrace.—Wiring and fittings.
Crofton Lodge, Orpington, Kent.—New storage battery, general overhauling of installation.
62, Finchley Road.—Electric light fittings, storage battery and plant.
New building, 180, New Bond Street.—Complete wiring throughout.
New Radium Institute.—Electric lighting and bells.

Trade Announcements.—THE NEW BROTHERTON TUBE CO., LTD., of Excelsior Works, Commercial Road, Wolverhampton, inform us that, by licence from the Board of Trade, they have altered the style of their firm to that of "Brotherton Tubes and Conduits, Ltd.," which name has been duly registered with the Registrar of Joint Stock Companies. The trade are requested to take note of the alteration for future correspondence and business.

MESSRS. TETLEY & CO., of Salford, have appointed Mr. S. Mansel Jones, of 7 and 8, Western Mail Chambers, Cardiff, and 63, Wind Street, Swansea, as their sole representative for Cardiff and South Wales; a stock of their standard manufactures will be held at each depôt.

MESSRS. J. & H. GREVENER have appointed Mr. Sandys Ball, of Monte Rosa, St. Leonards-on-Sea, as their representative for the South Coast.

Book Notices.—"Science Abstracts." Sections A and B. Vol. XII. Part 8. London: E. & F. N. Spon, Ltd. 1909. Price 1s. 6d. each section.

"Proceedings of the American Society of Civil Engineers." Vol. XXXV. No. 6. New York: The Society. 1909.

"Analyse des Métaux par Electrolyse." By A. Hollard and L. Bertiaux. Paris: H. Dunod & E. Pinat. 1909. Price 9 fr. 50.

"Calendar of the Municipal School of Technology, Manchester." Session 1909-10. Manchester: *Guardian* Printing Works. Price 6d.

"British Trade in Canada." Hints to Manufacturers and Commercial Travellers.—Published by the "Canada" Newspaper Co., Ltd., 34-35, Norfolk Street, Strand, London, W.C. Price 1s. net.

American Electrical Factories.—The course electrical trade is taking in the States may be gathered from the following remarks of our contemporary, the *Electrical World*, concerning the business of two of the largest electrical manufacturing undertakings there:—

"The entire force of the Westinghouse Electric and Manufacturing Co. at East Pittsburg was placed on full time last week, and is now working 10 hours a day. Heretofore a majority of the workmen were employed only eight hours. A representative of the company states that at the present time there are between 10,000 and 11,000 men on the pay-rolls, as compared with 6,000 at the low point last year. The gross business is now running at about $2,500,000 per month, or $30,000,000 per year. During July the business was $3,000,000, but this is recognised as being above the average. The foreign companies are also making excellent returns. In connection with this increased business, there has been a renewal of the talk of the early resumption of dividends. It is reported that the payment of the back dividends accrued on the preferred stock may be made in October, and that a 5 per cent. dividend on the assenting stock may be paid early in 1910. When the reorganisation plan was under discussion, those who took the assenting stock at par were assured that dividends would be paid at the earliest possible moment.

"Officials of the General Electric Co. report that business is slowly improving, but that as yet the majority of orders are for small machinery rather than for heavier apparatus. Manufacturing plants all over the country are considering the introduction of electrically driven machines, and many inquiries are being made, and many specifications being considered, in this direction. The demand for domestic appliances is said to be constantly on the increase."

Protection of Ely Cathedral.—Lightning conductors were first fitted to Ely Cathedral about the year 1859 to the specification of Sir William Snow Harris, F.R.S., adviser on lightning conductors to the Crown, but doubts were entertained as to whether these were still in an efficient condition. Mr. Alfred Hands, F.R.Met.S., author of "Lightning and the Churches," was therefore instructed by the Dean and Chapter to make tests and report as to the advisability of adopting more modern methods. Snow Harris's conductors, formed of short copper tubes screwed together, proved to be so defective that it has been found necessary to install an entirely new system of copper tapes. This comprises two conductors on the western tower with branches from the flagstaff and four turrets, two from the towers over St. Catherine's Chapel, and four from the eastern or lantern tower, as well as from the nave, choir, transepts and lady chapel. The system has been arranged so as to be scarcely noticeable, and does not detract from the appearance of the Cathedral, and the work has been carried out by Messrs. J. W. Gray & Son, of 91, Leadenhall Street, London, E.C., under Mr. Hands's direction.

"Lea" Recorders.—Among recent orders booked by the Lea Recorder Co., of Manchester, for these recorders are the following:—The Electrical Consumers' Co., Treforest, and the British Westinghouse Electric and Manufacturing Co., for the Buenos Ayres and Pacific Railway Co., recorders for measuring steam consumption; the Worthington Pump Co., for Birmingham Corporation, recorder for measuring condensing water; Messrs. Davis Perrett, Ltd., for the Central Electric Supply Co., repeat order for recorders for measuring steam consumption; also J. G. White & Co., for South America, for measuring boiler feed water; East Rand Proprietary Mines, South Africa, two more apparatus; also for Messrs. Babcock & Wilcox, and others.

Catalogues and Lists.—The Dowsing Radiant Heat Co., Ltd., 24, Budge Row, Cannon Street, E.C.—Twenty-six page illustrated catalogue of their electro-medical appliances, including "Solarium" or electric sun bath, constant, faradic and sinusoidal current apparatus, hydro-electric chairs, electrical vibration apparatus, high frequency apparatus, and luminous radiators.

The Midland Engineering Co., Ltd., 2, Victoria Square, Birmingham.—Folding circular containing a description, with sectional diagram, of the "Zylba" patent double-acting air pump, without foot or bucket valves.

Messrs Vickers, Sons & Maxim, Ltd., 32, Victoria Street, S.W.—Illustrated pamphlets describing the "Vickers" one-lock adjustable reamer and the operations connected therewith.

Schiersteiner Metallwerk G.m.b.H., Schwernistr, 3, Berlin W. 57.—Leaflets giving particulars of their automatic flashing switch, and motor-driven switch-gear in various sizes, for controlling electrically lighted signs.

The Lea Recorder Co., 28, Deansgate, Manchester.—Leaflet "2" relating to the Lea recorder for the measurement of water over weirs or through the V-notch.

Messrs. E. S. Hindley & Sons, 11, Queen Victoria Street, E.C.—Catalogue No. 330 dealing with the firm's high-speed vertical gas engines, and superseding previous lists. This catalogue is an excellent production, containing a specification and particulars of the essential features of the firm's gas engine productions, which are illustrated in sizes from the 12 B.H.P. single-cylinder engine to the 225 B.H.P. six cylinder engine. The constructive details of these engines include special features in cylinder design, ignition and governing; interchangeability has been carefully studied, and the makers emphasise the advantages of the type for export purposes, the net weight being only some 1 cwt. per B.H.P. The engines are specially designed for direct coupling to electric generators.

The Fortuna Machine Co., Ltd., Deacon Street, Leicester.—Leaflet relating to patent automatic hoisting winches for raising and lowering electric arc lamps, &c.

Messrs. Donovan & Co., Barwick Street, Birmingham.—Special net trade price list of a variety of electrical accessories, fittings, bells, blocks, cables, switches, conduits, and so forth; also a fully illustrated and priced circular of porcelain and brownware insulators.

Messrs. Erith's Engineering Co., Ltd., 70, Gracechurch Street, E.C.—Illustrated leaflet, No. 193, relating to the Erith grateless underfeed stoker. A working chart shows the load fluctuations in the electric traction steam plant which operates the St. Clair tunnel electric trains. The two large boilers with Erith's grateless stokers are shown to keep a practically constant steam pressure, although the load ranges in only 14 minutes, between a merely nominal load and a peak load of 1,700 KW., and down to nominal load again; it is claimed that with this system both fuel and air simultaneously and automatically respond to variations of load.

Messrs. Alley & MacLellan, Ltd., Sentinel Works, Polmadie, Glasgow.—New catalogue (No. 24 E) of 40 pages wherein they give full descriptive notes with excellent half-tone and line diagrams of the Sentinel Junior engines for electrical and other service. Tabular, price and other particulars are also given of boilers, dynamos and piping for working with same, in order to enable the purchaser to easily ascertain the cost of a complete plant delivered on site. Other plant shown in the catalogue includes air compressors, steam-motor wagons, steering gears, hoisting machinery, and valves and fittings.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.—New 50-page catalogue very fully particularising, with a large number of illustrations, their "Kalkos" tinned-tube wiring system. A large number of new fittings and appliances have been added which are intended to render the system more complete, and its application still wider, than it already was. In many cases considerable reductions have been effected in prices of both tubes and fittings. Wiring contractors and others interested in wiring systems should find the catalogue of service.

Union Electric Co., Ltd., Park Street, Southwark, S.E.—Advance copy of a well-illustrated brochure of 16 pages, containing views of a number of high and low-tension switchboards recently manufactured by them.

The Lahmeyer Electrical Co., Ltd., 109-111, New Oxford Street, London, W.C.—Two new illustrated lists: one (No. 7,014) describing their latest type of high-speed motor for large outputs, with the windings specially insulated in accordance with the mining regulations. The company also supply motors with vertical shafts for all outputs and voltages in commercial use, and specially suited for modern shaft-sinking pumps in mines. The other list (No. 7,087) describes their single and three-phase oil-immersed transformers, showing a number of their most recent installations of the latest type, and summing up their advantages. We have also received from this company a 24-pp. catalogue in stiff red covers in which they give a great deal of tabulated data (sizes, weights, resistances, &c) with prices, of vulcanised india-rubber wires and cables, flexible wires, overhead wires, &c., of the Felten and Guilleaume-Lahmeyerwerke A.G., whose works the reader finds, have an annual production of 120,000 tons, employ 6,500 hands, have equipment which comprises engines of 7,500 H.P., and are fitted for the testing of cables up to 60,000 volts.

Messrs. S. H. Heywood & Co., Ltd., Reddish, Stockport.—Folding card illustrating and describing an electric overhead travelling crane of unusually wide span that they have recently built.

A large and effective wall show card presumably intended for shop windows or walls has been issued to inform the metal-filament lamp-using public that the "Aegma" lights the world. It depicts a writer who has been moved by this great thought, sitting before a remarkably tidy desk with a lighted "Aegma" above his head shedding its rays upon a revolving globe. He is writing on "A light subject," but what he is putting down no one but a compositor could make out!

Messrs. Charles Price & Son, Broadheath, near Manchester.—Catalogue (No. 3) of 20 pages devoted to paraffin, petrol and other engines petrol, electric lighting sets, and so on. An accompanying tabulated list gives prices, code-words, shipping dimensions, &c. The firm have on order at the present moment, paraffin and petrol engines of 1, 2 and 4-cylinder types for lighting purposes, for South Africa, South America, Siam, Holland, Sweden, and for the home markets.

The Langdon-Davies Motor Co., Ltd, Southwark Works, Deverell Street, S.E.—Pamphlet containing, in addition to lists of the firm's standard D.C. and A.C. (one, two and three-phase) motors, a few useful tables of mechanical data. One gives power equivalents in watts, horse-power, forces de cheval, and kilogrammetres per minute (the words "per minute" should be added in the fourth column heading).

Works in America.—The following statement appears in the daily Press:—"In view of the extent to which they find their trade in balata and other beltings with the United States handicapped by the high tariff, the directors of R. and J. Dick, Ltd, of Glasgow, have decided to establish a factory in that country. The matter has been the subject of prolonged consideration, but as no way out of the difficulty could be found, the decision mentioned was arrived at. A number of the directors left Liverpool on Saturday for America to select a site, and to decide whether the factory shall be built on American or British lines."

The Silvertown Company.—A number of the daily papers have published statements to the effect that the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., were going to remove their works from the borough of West Ham, owing to the heavy rating. It is, of course, a fact that the company pays

an unconscionably heavy sum every year in rates without having a voice on the Council as to the conduct of the municipal affairs, but the statement of removal seems to go a little too far. The company is not leaving West Ham, but it is not extending there. For increased manufacturing facilities that are required by the company, the directors propose to erect a factory in the provinces, and a Midland centre may be selected, but nothing definite appears to have been decided.

Bankruptcy Proceedings.—E. A. Brandon.—The creditors of Ernest Austin Brandon, mechanical and electrical agent and factor, trading at 33, Devonshire Chambers, Bishopsgate Street, E.C., under the style of E A. Brandon & Co., met on Wednesday last week at the London Bankruptcy Court. The Official Receiver reported that the debtor had stated that he commenced business in January, 1906, with £50 cash capital, at 55, Barbican, E C. He removed to Devonshire Chambers in June, 1907, and had since traded there under the same style, also in a small way as the Atlas Engineering Co. The failure was ascribed to lack of capital and bad trade. A statement of affairs was lodged, showing unsecured debts £1,137, and fully secured debts £839, the assets being valued at £5 11s. 8d. In the absence of any offer the case was left in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy. Appended is a list of the principal creditors:—

Armorduct Mfg. Co.	£63	W. Richards & Son	£16
Oswald Carr	94	Sloan Electrical Co.	39
City Glass Co.	22	John Spencer, Ltd.	64
T. W. Dickson	22	International Elec. Co.	88
Electrical Co.	89	Tubes, Ltd.	107
Enright & Thompson	88	Lloyd, Richardson & Co.	60
Foster Arc Lamp and Eng. Co.	10	E. P. Allen & Co.	10
Gilbert Gilkes & Co.	14	Alice E. Barnes	42
J. & H. Grevener	14	J. Macgregor	32
Hobbs, Hart & Co.	33	E. E. Patland	48
F. Krasa & Co.	19	J. Buckingham	18
London Sherardising Co.	12	W. H. Nicholls & Son	13
Ercole Marelli & Co.	59	Fully secured creditors	839
Morris-Hawkins, Ltd.	45	Preferential creditors	14
Rhodes Motors, Ltd.	40		

Herbert J. Burdett, electrical engineer and contractor, 16, Regent Street, Rugby, and Coventry.—A receiving order has been made on debtor's own petition at Coventry.

"Victoria" Turbo Pumps.—Messrs. Willans and Robinson, Ltd., have recently taken up the manufacture of centrifugal pumps, for dealing both with high and low lifts, and have at the present time some 12 pumps under construction. We understand that a series of tests has recently been completed on one of these pumps, which has shown that the high efficiency estimated by the designer (Mr. Jens Orten-Boving) has been fully realised in practice. The pumps in question are of a particularly simple design, and are being built with a view to requiring the minimum amount of attention in working. In view of the large number of high lift sinking pumps imported into this country, it is felt that there is plenty of room for a well-built reliable British-made pump.

LIGHTING and POWER NOTES.

Aberdeen.—Mr. J. A. Bell, electrical engineer to the Corporation, in his annual report, states that the year just completed has been unique in the experience of the department, being the first since the start of the undertaking in which the units generated show a decrease on the preceding year. Due, however, to economies in distribution, &c., the output sold shows a small increase. This small increase in output is partly due to the general depression in trade, but it is principally the result of the installation of metallic-filament lamps by the present consumers. It is estimated that there are already on the mains some 25,000 metallic-filament lamps which have displaced the older type of carbon-filament lamp. Motors representing 408 H.P. have been coupled up since the last report. The output for private lighting consumers for the year was 14,024 units, and for the power consumers 65,851 units in excess of the previous year. The total number of units sold for the year for all purposes amounted to 5,170,421, being an increase of 66,385 over the preceding year. The Electricity Committee has agreed that a uniform rate of 3¾d. per unit for lighting be fixed, with the alternative to consumers using over 5,000 units per half year to elect to be charged the same rate as at present, viz., 5½d. per unit for the first hour of maximum demand, and 1½d. per unit for all subsequent demand. A flat rate of 1½d. per unit for cooking and heating was also fixed.

Australia.—The Sydney Council has invited tenders for the erection of an eight-cell refuse destructor at Pyrmont; steam plant will be installed, including Babcock & Wilcox boilers.

The Sydney Electric Light Committee has decided to call for fresh tenders for turbine equipment. It will be remembered that Mr. Mackay, the engineer, protested against a proposal to install a 4,000-KW. set at 1,500 R.P.M., with a view to saving in capital cost, on the ground that a lower-speed machine was preferable.

Bentley (Doncaster).—A L.G.B. inquiry was held recently as to sanction to carry out a scheme of sewerage for Bentley colliery model village, Rostall, and also building estates up the Askern Road. The engineers—Messrs. D. Balfour and Son, of Newcastle-on-Tyne — fully explained that the sewage will be conveyed to a pumping station, where, after screening, it will be discharged into two separate tanks from which it will be pumped by centrifugal pumps worked by electric motors in duplicate. The pumps will be placed in an underground chamber adjacent to the storage tanks and worked by a spindle from the motors in the motor house to be built above ground. The motors will be automatically started and stopped by floats. Each pump will be capable of delivering 30,000 gallons per hour of sewage at the existing sewage disposal works.

Brazil.—An electric driving plant is being installed at the mills of the Rio de Janeiro Flour Mills and Granaries, Ltd., and the concern has contracted with the Rio de Janeiro Light and Power Co., Ltd., for the supply of the necessary electric energy—about 1,800 H.P.

Brighouse.—The electricity supply was inaugurated at Brighouse on Monday. The old generating station in Hall Street, which has for a long time inadequately met the growing requirements of the district for electric light and power, has been superseded by the completion of the bulk supply arrangement with the Yorkshire Power Co., and distribution by the Corporation to its customers. The cost of the new transformer installation has been £2,950.

Chile.—A company has lately been formed at Antofagasta, with a capital of £30,000 and the title La Companhia de Alumbrado y Fuerza Motriz Electrica do Antofagasta, to establish an electric generating station for lighting and power purposes in the town.

Continental Notes.—Russia.—The Kharkov City authorities have applied for powers to contract a loan of about £633,000, bearing 5 per cent. interest. Among other things, it is proposed to devote £100,000 to electric tramway construction, and a further £50,000 to the building of a new electric station for lighting and power purposes.

Sicily.—Two hydro-electric stations are in course of construction on the Cassibile, to the south of Syracuse, and on the Alcantara, near Taormina. It is intended to link the two plants and to supply power by electric transmission to the whole of the east coast of Sicily, from Messina to Syracuse, and eventually to Ragusa. The length of this line will be about 220 km., and for the present it will be fed from the central stations of Cassibile and Alcantara. The requirements of the region are estimated at about 10,000 H.P. —viz., Catania, 5,000; Messina, 3,000; Syracuse, 1,500; and Taormina, 500.

A further project is on foot for the establishment of an electric power station on the River Simato capable of producing 10,000 H.P. It is calculated that the hydrologic conditions of Sicily would permit of the erection of hydraulic stations over the island capable of generating about 50,000 H.P., and it is thought that it would be possible to link such stations together, so as to embrace the whole island with the principal stations at Palermo, Messina, Catania and Syracuse.—*Board of Trade Journal.*

Galicia.—The municipal authorities of Tarnow have lately invited tenders for the establishment of a central electric lighting station in the town.

Bohemia.—The municipal authorities of Rochlitz have recently decided on the establishment of a central electric lighting station in the town.

Dartford.—Mr. J. D. Pember, resident engineer, in issuing his report on the working of the Council's electricity undertaking, points out that the last year's working was the first in which a profit has resulted since the supply was commenced in 1901. Briefly, the revenue amounted to £8,230, as against £7,920 in 1907-8; working expenses amounted to £5,405, being a reduction on the previous year, which is attributable mainly to a saving of nearly ½d. per unit on coal consumption, due to the use of improved furnaces. Including all financial charges, the total expenditure amounted to £8,173, leaving a net balance £57, as compared with a deficit of £1,145 in 1907-8. Mr. Pember's report shows that the output sold amounted to 904,999 units, being an increase of 68,797 units, towards which power supply contributed 66,000 units. The tramways took some 13,000 fewer units than in the previous year.

Farnworth.—On Thursday last week the new extensions to the U.D.C. electricity plant were officially opened. It will be remembered that on the advice of the engineer, Mr. R. B. Leach, the Council decided to purchase energy in bulk from the Lancashire Power Co., and to install suitable plant at its own generating station for dealing with this supply. The power company's supply is delivered as three-phase current at 10,000 volts and 50 cycles; this is dealt with in two 300-H.P. Westinghouse transformers, with a step-down ratio of 10,000/500 volts, and converted to direct current at 500 volts by two G.E.C. 270-KW. motor-generators running at 600 R.P.M. The switchgear, both H. and L.T., has been supplied by the Westinghouse Co. The Council has agreed to purchase a minimum of 400,000 units per annum from the company; the Council's output last year included 411,926 units for traction, 89,354 for lighting, 222,416 for power, and 55,672 for street lighting, making 779,368 units in all. At the same time a Heenan & Froude refuse destructor, to deal with 45 tons per working day, was officially opened. This plant is of the Heenan "front feed" type, combined with a Lancashire boiler, regenerator, Green economiser, &c., and is estimated to be capable of generating some 400,000 units per annum in connection with the electrical undertaking. The boiler was supplied by Messrs. Musgrave & Sons, Bolton, and is provided with Hopkinson fittings and a Foster superheater.

Fife.—The contractors for the Rosyth Naval Dockyard works—Messrs. Easton Gibb & Son—are to erect a private power station at Rosyth. An order has been placed with the National Gas Engine Co., Ltd., for four gas engines and suction gas plants with a maximum output of 1,100 B.H.P. Electric current is to be supplied at 500 to 550 volts to all the workshops on the site. Besides lighting, the electric power will be used on the cranes, in the machine shops and sawmill, and for pumping. It is estimated that the cost of energy will not exceed ⅝d. per unit, including all standing and working charges. The intention at first was to get power from one of the large private companies in Fife.

Little Lever.—The U.D.C. has under consideration an application from the Lancashire Electric Power Co. for permission to supply electricity to several premises in the township by means of overhead wires along Booth Road and Market Street.

London.—HACKNEY.—Application is to be made to the L.C.C. for sanction to borrow £3,650 to cover certain expenditure on cables for giving an increased supply in the Hackney Wick and other districts. The Electricity Committee is informed that Messrs. G. Ellis & Co. intend to install a further 200 H.P., also that Messrs. Austin & Son are erecting a factory, and will require some 150 H.P., and it is consequently the intention to carry out the work without delay.

Longton.—The Gas and Electricity Committee has recommended the T.C. to amend the scale of charges for power so that consumers of more than 10,000 units per quarter may be charged at 1d. per unit.

Mansfield.—The T.C. has received from the L.G.B. sanction to a loan of £500 for economiser extension and water softening plant.

Mexico.—The British Vice-Consul at Guadalajara reports that the interests of Senor Don Manuel Cuesta Gallardo and the Compania de Tranvias, Luz y Fuerza de Guadalajara, Sociedad Anonima (Tramways, Light and Power Co., of Guadalajara, Ltd.) have now been merged, and that a well-known Berlin firm have contracted to advance £750,000 for the construction of works and the erection of machinery for the production of hydro-electric power on the Santiago River. In addition to the power scheme, 300,000 hectares (about 750,000 acres) of land will be drained and irrigated, and, under the Irrigation Law, the Mexican Government will pay the irrigating company the sum of $25 for each hectare (£1 per acre) irrigated by them. Guadalajara is already supplied with over 10,000 H.P. of electrical energy by the old company, but the new company is installing turbines to give an additional 8,400 H.P., which will be largely used by the mines in the Hostotipaquillo district of the State. It is possible that electric power may even be transmitted from the generating stations to Aguascalientes in the State of that name, where important industries requiring power exist.

Northampton.—Considerable extensions to the lighting mains are about to be carried out by the E.L. and Power Co., Ltd.

Portsmouth.—Since June, 1894, when the T.C. started to supply electricity, the rates of the borough have been relieved by means of its electricity undertaking by a total sum of £12,000. But, up to six years ago, only £1,000 had gone in relief of rates. It was in that year that Mr. W. S. Foale was appointed engineer and manager, and under his management a profit of £11,000 has been made since 1903, and the reserve fund, which then stood at £7,725, has been increased to £27,823, while an insurance fund, with £3,871 to its credit, has also been started. The revenue in that short period has grown from £35,000 to nearly £49,000, which was the total of receipts last year, although that represented a decrease of £6,500 in a year, due chiefly to concessions to private consumers and the abolition of meter charges. The Council has, during the years it has owned the undertaking, increased the number of arc lamps for street lighting from 78 to 432, besides 463 incandescent lamps. The total number of units sold last year aggregated 3,476,000. There is not much manufacturing carried on in the town, so there is little demand, comparatively, for electricity for power purposes, although the demand increased last year from 204,559 to 343,390 units.

Runcorn.—The Castner-Kellner Co., having asked the R.D.C. for consent to its application for a prov. order for electric lighting, the Council has asked for full particulars of the scheme.

Swinton and Pendlebury.—The Council is to consider a recommendation of the Electricity Committee that it appoint an electrical engineer for the management of the undertaking; the undertaking is now managed by the Lancashire Electric Power Co., to whom the Council pays £150 annually for such services.

Tavistock.—At a meeting of the U.D.C. on Tuesday, Mr. Foster (chairman of the Lighting Committee) stated that, in view of applications being made by an outside firm for a provisional order to supply Tavistock with electric light, the Lighting Committee recommended that the Council should apply to the B. of T. for a provisional order. He contended that if they were going to have electric light in Tavistock, the Council should be the proprietors, and not a private firm. Mr. E. C. Spooner seconded the motion. He knew of towns where the introduction of electricity in the hands of the local council had been a paying affair, and it was a good investment. The clerk stated that they would be required to deposit £50 to cover the ordinary expenses of the order, and pay any additional expenses. After a long discussion as to the advisability of such a course, it was resolved to refer the matter back to the Committee for further consideration.

Southport.—The Electric Lighting Committee has appointed a deputation to interview the Birkdale District Electric Supply Co. on the question of supplying electrical energy at Ainsdale, a suburb of Southport.

Wimbledon.—At the last meeting of the Council it was reported by the borough electrical engineer that although the contract for the erection of the Howden-Siemens turbo-alternator should have been completed by April 30th, he anticipated that it would not be until September 22nd that the plant would be ready for running on load. The foundations were completed on February 18th.

TRAMWAY and RAILWAY NOTES.

Argentine.—According to the *Review of the River Plate*, the Lacrose Tramway Co. (Buenos Ayres) is proposing to add some 15 km. to its tramway routes. The power plant will be correspondingly increased, and it is intended to add two 2,300-H.P. engines, coupled to 1,500-KW. generators; this additional 3,000 KW. of plant brings the company's installation up to 6,000 KW. The boiler plant, consisting of seven Babcock boilers, will also be extended. Some 50 additional two-axle cars, and 20 four-axle cars are being put into service to deal with the increased traffic, and a shed to accommodate 150 cars, together with repair shops, is to be built and equipped. The company has just opened a new route between Calle Reconquista and Villa Urquiza.

Australia.—The report of the Government Commissioner on the working of the State railways and tramways for the year ending June 30th last shows that 151¼ miles of tramways were worked, carrying 185 million passengers, an advance of 14 millions on the previous year. The undertakings earned £1,097,565, and the return, after meeting working expenses, was £5 12s. 6d. per cent. on the capital invested.

Mr. J. A. Boyd, who recently spent considerable time in examining the various electric railways in Europe and America, has on his return to Melbourne presented a report to the Premier, urging that further consideration should be given to the suburban electric railway scheme for Melbourne which was rejected by the Victorian Railway Commissioners.

Mr. Boyd has come to the conclusion that the single-phase system with overhead trolleys offers a greater chance of success than the direct-current third-rail system suggested by Mr. Mers; he advocates that Mr. Mers, or some qualified American engineer, should make a further report on a scheme for single-phase traction. He quotes the views of Mr. McHenry and Mr. Murray, of the New York, New Haven and Hartford Railroad, that the single-phase section is not only preferable but more profitable than the direct-current third-rail section of that company's line. Mr. McHenry further stated that on the Long Island Railroad, with the protected third-rail, it was found necessary to employ an independent staff to look after it.

Continental Notes.—NORWAY.—The first Norwegian single-phase railway has been recently installed by the British Westinghouse Co. between Thamshavn and Lokken. The line runs through the valley of the River Orkla and serves to tap the rich ore deposits there, as well as to deal with a rising tourist traffic. It passes through seven stations in all. The power for the line, as well as for the town of Thamshavn, the various villages along the line and for the mines at Lokken, is derived from a waterfall near Thamshavn. The power is generated and conveyed to the various towns as a three-phase supply at 15,000 volts, 50 cycles, whilst the power for the railway line is converted into a single-phase supply at 6,000 volts, 25 cycles, by means of motor-generators in a sub-station at Thamshavn. This sub-station forms part of the main station and contains two 250-K.V.A. motor-generator sets with room for a third set as well as for three oil-cooled three-phase 15,000/6,600-volt transformers for 250 K.V.A. each. The motor-generators each consist of a three-phase 6,600-volt, 50 period induction motor with slip rings direct-coupled to a 6,600-volt, 25-cycle single-phase generator. The trolley wire voltage is automatically controlled by a Tirrill regulator. The single line track laid down is of 1 metre gauge, and is, on the whole, very level and free from curves, though at one point gradients up to 4 per cent. exist. The station buildings are provided with incandescent lamps supplied, through small transformers, from the trolley wire. The trolley wire has a catenary suspension, and is divided into six sections by section insulators, which are normally short-circuited, but can be opened by hand by means of a long pole when necessary. The rolling stock consists of three locomotives, one saloon motor carriage, four passenger carriages, and 21 goods trucks. Each locomotive weighs 20 tons, and carries four motors—two on each bogie. The locos. are fitted with automatic couplings, Westinghouse air brakes, and pantograph bow collectors. The motors are Westinghouse compensated series ones for a one-hour rating of 40 H.P., and are geared to the axles through spur gearing having a 14 : 76 ratio. Each loco. can exert a draw-bar pull of 6,600 lb. at a speed of 11¼ miles per hour. The four motors are used in two groups of two in series. The regulating transformer carried on the locomotive has seven tappings on the low-tension side for 110, 240, 300, 360, 420, 480 and 540 volts respectively.—*E. K. and B.*

FRANCE. — The important French railway Paris-Lyons-Méditerannée is at present carrying out experiments in conjunction with Messrs. Alioth, with a view to converting the Cannes-

Vintimille section of its line from steam to electricity. The experiments are being made on the Grasse-Mouans-Sartouse section, which is very convenient for the purpose, as it includes some of the steepest gradients and sharpest curves, and is also not crowded with traffic. The overhead wire is suspended flexibly by means of a system patented by Messrs. Alioth, which does not involve the use of separate suspension wires. Wooden poles are used at present, but these are to be replaced by metal lattice work supports later on. The locomotive used weighs 140 tons, and is approximately the same length (65 ft.) as the normal steam locomotive, including the tender. There are eight axles, of which the four central ones are driving axles with large wheels. The overhead line is supplied with single-phase alternating current at 12,500 volts, but this is converted on the locomotive by means of a special permutator, devised by Messrs. Auvert & Ferrand, into direct current at a voltage adjustable between 0 and 600 at will. The motors are ordinary direct-current ones of 450 H.P. each, and there are four of them. They are flexibly geared by means of spur gear to the four driving axles. The total draw-bar pull exerted by the locomotive is 16,400 lb. at a speed of 37 miles per hour, and 10,600 lb. at a speed of 62 miles per hour.—*E. K. & B.*

Erdington.—An extension of two years for completing the lines under the Tramways Act has been granted to the U.D.C. by the B. of T.

London.—Arrangements have been made for opening the widened portion of Blackfriars Bridge on September 14th; the tramways connecting the Embankment and Blackfriars Road sections will be opened at the same time. It is stated that the Bridge House Estates Committee will adopt the St. Paul's Bridge scheme, and that the Castle Baynard Ward strongly favours the construction of tramways on the new bridge and their subsequent lease to the L.C.C.

Newcastle-on-Tyne.—MR. ERNEST HATTON, general manager of the Corporation Tramways, has just issued his annual report. It is for the year ended March 31st, 1909, and in it Mr. Hatton says that the total mileage of single track worked by the Corporation is 60¼ miles, of which the Corporation owns 54¼th. In reference to the maintenance of plant in the power station, he states that the two batteries originally installed at the station have been replated, and put into first-class condition, and two automatic reversible boosters have also been installed, working in conjunction with those batteries. He continues: It is too early for me to speak definitely as to the actual saving to be accomplished, but I might state that since the above plant has been put into commission, whereas previously we were compelled to run our two largest generating sets in parallel during the heavy peak loads in the winter months, due to the workmen's traffic, we have since been able to run through the heavy evening loads with one generating set running in conjunction with the batteries referred to. Also during the summer months we are now able to shut down the running plant for some hours during the night, as the batteries are at this period capable of taking the load on the station. During the year the two sets of pumps have been installed in the pumping station on the riverside, and an additional suction pipe 2 ft. in diameter has been laid from the pumping station under the quay to the river. This plant is now in successful operation, and from the results obtained so far will show a saving of 25 per cent. in the current used for circulating purposes. With the installation of this plant one of the serious difficulties which the department has laboured under for the last four years is now at an end, and the additional plant which has now been installed in the pumping station is now fully capable of dealing with the loads that we are likely to get on the power station for many years to come." The low consumption of coal is still continued, the coal consumption per unit being 3·57 lb., and the average saving in tonnage during the past four years has been 2,417 tons per annum, representing £937 9s. 2d. per annum. The total B.T.U. generated was 9,864,969, a decrease of 143,616 units, which is accounted for by the service of cars being curtailed during the period of the strike which prevailed during the year. Of the total output, 8,118,719 units were utilised for traction. The car-miles run were 4,289,997, and the consumption was 1·892 B.T.U. per mile. The coal consumption during the year was 15,742¼ tons. As to the finances (of which details have already been given in our columns) Mr. Hatton says, "The revenue of the undertaking shows a considerable decrease both in the gross takings and in the earnings per car-mile. This is largely accounted for by the unfortunate strike which embraced the whole of Tyneside during the financial year under review, as also by the extra facilities given to the workpeople and in the extensions of fare charges. The pronounced increase in the general expenses is due to one cause only, viz., the large increase in the rates on the excessively increased assessment referred to in my last annual report." He states that the expenditure on the maintenance of the cars shows an increase over the previous year, and that it is unlikely that that item can be reduced. The cost of maintenance of permanent way shows a considerable increase, and he comments on the difficulty of increasing the revenue.

Pontypridd.—The refusal of two employés of the Council's tramways undertaking to join the tramway men's union will probably result in a strike of the other employés in a week, unless the two employés consent to join the union or are dismissed. At a meeting of the men it was pointed out that there were no differences between the Council and its employés.

Salford.—The Tramways Committee recommends the discontinuance of the system of return tickets for workmen, and the concessions to the female workers and school children, on the ground that the 12 months' experiment has led to a great decrease in traffic receipts.

South Shields.—At a meeting of the T.C. on the 1st inst. Mr. Wylie moved the adoption of the Tramway Committee's report for the past year. He said this was the first year in which they had to face any renewals out of revenue, and their balance, although he admitted that it was small, would bring up their reserve fund to practically £6,000. There were one or two savings that they hoped to make in the near future. There would soon be a reduction in the sinking fund, and they also hoped to make a reduction in the cost of power. Mr. Henderson seconded the adoption of the report. He pointed out that on the turnover of £29,600 they were only down £182. In Newcastle-on-Tyne, where, of course, the undertaking was very much larger, they were down £9,000, and Sunderland, which was a system twice as large as that of South Shields, was also down £9,000. He pointed out that their working costs came out very low—at 5·73d., compared with Newcastle-on-Tyne, 6·28d., and Sunderland, 6·38d.

Wakefield.—The Wakefield and District Light Railway Co. has applied to the B. of T. for permission to abandon portions of the tramways authorised under the Order of 1901-2, viz., a portion in Horbury, the line to Alverthorpe, a portion from Rothwell to Oulton, and a portion of the Ardsley line.

Wallasey.—The U.D.C. has decided not to put out to tender the work of constructing the extension authorised by the Wallasey Tramways and Improvement Act, 1909, but to carry it out by the Council's own departments. Major Greene (tramways manager) and Mr. G. H. Travers (engineer) will forthwith proceed with the work.

Whitworth.—It is intended to commence the construction of the new tramway from Ending through the Whitworth Valley early next spring, and the extended lines are expected to be ready for traffic about three months later. The question of a through service of cars to Bacup has been revived, and the prevailing feeling is that Rochdale should construct the track in the Bacup section, and run the cars on a lease, as the Rawtenstall Corporation is doing in another part of the Bacup borough. The Rochdale Tramways Committee has received a letter from the town clerk of Bacup on the matter, and the whole question has been referred to a Sub-Committee.

TELEGRAPH and TELEPHONE NOTES.

Cable Interruptions and Repairs:—

	Interrupted.	Repaired.
Tangier-Cadiz	May 19, 1909	
Tourane-Amoy	June 17, 1909	
Assab-Perim	July 8, 1909	
Gibraltar-Tangier	Aug. 7, 1909	
Dakar-Conakry	Aug. 20, 1909	
Balikpapan-Kwandang	Sept. 2, 1909	

Russia and Press Telegrams.—The Russian Government has agreed to the introduction of a Press tariff over the Siberian telegraph lines, and the Great Northern Telegraph Co. will shortly be able to accept Press messages for China, Japan and the Philippines at the rates prevailing on the Eastern Telegraph system.

Telephone Statistics.—An examination of official statistics shows that Germany, Australia (Commonwealth), Austria, Belgium, Bosnia, Bulgaria, Cape, Ceylon, Portuguese Colonies, Denmark, Egypt, Spain (Government only), France, Great Britain and Ireland, Greece, Hungary, Dutch Indies, French Indo-China, Iceland, Italy, Japan, Luxembourg, Madagascar, Natal, New Caledonia, Orange River Colony, Holland, Roumania, Russia, Servia, Switzerland and Tunis together used the telephone 3,964,721,335 times, and about £14,000,000 sterling was paid for these calls. It will be noticed that figures for the whole of America (North, South or Central) are not included.

Wireless Telegraphy.—From Canadian contemporaries we learn that the amount of damage done to the Marconi wireless station at Glace Bay was about $8,000. All the receiving and sending apparatus in the operating room was destroyed, as well as a good many duplicate parts for the station which were stored in the condenser room. The loss of instruments is not included in the above sum. Mr. Paget, manager of the Marconi Co. at Port Morien, informed the *Montreal Gazette* that it would take a month to restore communication, and that the spare instruments on hand were insufficient for this purpose.

The fire started, he states, in the main office of the sending department, and nothing has been left standing except the boiler house and the four huge towers. One of the latter is badly damaged, and was only saved from destruction by the energetic steps of the staff and firemen.

It is reported that the Dominion Government contemplates spending $36,000 in improving the wireless telegraphic system on the Pacific Coasts. Certain stations are to be enlarged and new ones built at points to link up a chain throughout British Columbian waters.

The steamers *Ben-my-Chree*, *Empress Queen* and *Viking*, sailing between Liverpool and the Isle of Man, are now fitted with wire-

less, and the charge for telegrams (*via* Seaforth) is 1½d. per word, with a minimum of 1s. 6d.

Wireless Telegraphy and the Post Office.—As the result of the negotiations which have been in progress for some months, it is reported that the Marconi Wireless Telegraph Co. has agreed to transfer six of its wireless telegraph stations to the Post Office, for a consideration not yet disclosed. The stations in question are situated at Liverpool (Seaforth), the Lizard, Niton (I. of W.), Caistor, Crookhaven (near Queenstown), and Rosslare. The company's licence for these would have expired in three years. The trans-Atlantic service *via* Poldhu and Clifden remains in the hands of the company, as well as the communication with lighthouses and lightships; but the Post Office has secured the right to use the Marconi system for 14 years for communication between the mainland and islands off the coast of the United Kingdom, thus avoiding the cost of laying and maintaining cables. The Post Office will work the wireless system as part of the general telegraphic system of the country for communication with passing ships and with islands. It is anticipated that the stations at Withernsea and Hull, now disused, will be re-opened. The Post Office takes over the North Foreland station, which at present is under the joint control of the Marconi Co. and Lloyd's, an arrangement which has caused some friction. The company will retain control over its installations on board ship, which number about 230. The present staff of the shore stations will be taken over by the Post Office for a year, and the Government may eventually retain their services.

In reply to a question in the House of Commons on Tuesday, the Postmaster-General stated that the above announcement was premature, and did not emanate from the Post Office, as the arrangements were not yet complete, and were, to some extent, contingent upon negotiations with Lloyd's, which also were not complete. He promised to make a statement when they were completed.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—100,000 porcelain insulators for the P.M.G. See "Official Notices" to-day.

Telegraph and telephone material for the P.M.G. Melbourne. See "Official Notices" to-day.

Common battery switchboard for the North Sydney Telephone Exchange. See "Official Notices" to-day.

Belgium.—September 28th. La Société Nationale des Chemins de Fer Vicinaux of Brussels (14 Rue de la Science) are inviting tenders for the supply and erection of the overhead equipment for the Anderlues-Lobbes section of the Carnieres-Thuin electric railway.

Bristol.—September 21st. E.L. installation at Alexandra Park Schools, Fishponds, for the T.C. (deposit £2 2s.); Rodway and Dening, architects, Gaunt House, Orchard Street, Bristol.

Burnley.—September 20th. The Guardians are inviting tenders for electrical supplies to the workhouse. Particulars from the Clerk, to whom tenders must be sent by the 20th inst.

Canada.—Toronto.—October 14th. A New York Exchange says that the city of Toronto is inviting tenders for four 1,500-H.P. synchronous motors, two 1,500-H.P. induction motors, four 500-H.P. induction motors and two 225-H.P. synchronous motors, with exciters, switchboards and connections; also for a number of large-sized turbine pumps, piping, valves, &c.

Dublin.—September 13th. 750 A.C. meters, single-phase, for the Lighting Committee. See "Official Notices" September 3rd.

Fulham.—September 22nd. 150 electricity meters for the Corporation. See "Official Notices" to-day.

Great and Little Usworth (Co. Durham).—Lighting certain roads (overhead lines) by electricity, for the P.C.; J. R. Elliott, clerk to the P.C., Fern House, New Washington.

Grimsby.—September 17th. Paper-insulated lead-covered cables for the Corporation. See "Official Notices" September 3rd.

Hungary.—September 18th. Tenders are being invited by the municipal authorities of Magyarkanizsa, for the establishment of a central electric lighting station in the town.

Isle of Thanet.—Stores for the Isle of Thanet Electric Tramways and Lighting Co, Ltd. See "Official Notices" September 3rd.

London.—L.C.C.—September 14th. The L.C.C. wants tenders for the supply and laying of 6½ miles of 0·075 sq. in. three-core cable and 46 miles of single-core cable, telephone cables, &c.; the supply of 50 tramway feeder pillars; laying 16 miles of stoneware ducts; and the supply of 440,000 stoneware ducts. See "Official Notices" August 6th.

L.C.C.—September 21st. Two 500-KW. and 150-KW. motor-generators, also high and low-tension switchgear, for sub-stations; steam and other piping, valves &c., for Greenwich generating station. See "Official Notices" August 27th.

Oulton Broad.—The U.D.C. invites applications from those willing to carry out its E.L. order. See "Official Notices" to-day.

Transvaal.—The *Board of Trade Journal* quotes a South African paper to the effect that the tenders are to be invited for the supply, to the Johannesburg Town Council, of electric generating plant, &c., to the value of some £57,000, as follows:—Four boilers, each capable of producing 14,000 lb. of steam per hour, £9,460; four mechanical stokers, £3,200; economisers, £2,000; one chimney and necessary flues, £2,200; steam, exhaust and circulating piping, £1,500; two cooling towers, £2,000; cooling pond, £750; two feed-pumps and house, £600; one borehole and pump, complete with house, and reboring existing borehole, £790; removing six boilers, steam pipes, &c, £500; engines, about £34,000.

CLOSED.

Admiralty.—The Electrical Apparatus Co., Ltd., has received the Admiralty contract for all enclosed fuses, from 35 to 60 amps. inclusive, up to December 31st, 1911.

Birkdale.—The U.D.C. has accepted the tender of the Horsfall Destructor Co., Ltd., of Leeds, for a refuse destructor, at £2,699.

Blackburn.—The T.C. has accepted the tender of the Wigan Coal & Iron Co., Ltd., for coal for the electricity works.

Bradford.—The Corporation Electricity Committee has recommended the acceptance of tenders as follows for the work of installing electric light and power plant at the Technical College:—

Crosthwaite Fire Bar Syndicate, Ltd.—Cooling tower, £168.
Cole, Marchent & Morley.—Low-speed engine, with rope pulley, also surface condenser and jet condenser, £1,200.
Campbell Gas Engine Co.—Gas engine, with suction gas plant, starter, &c., £1,100.
Tudor Accumulator Co.—Battery of 220 cells, £332.
Siemens Bros., Ltd.—Motor-generator, £171.
Phœnix Dynamo Co.—High-speed set, low-speed set, booster and balancer, gas set, £600.
Thwaites Bros., Ltd.—High-speed engine, £260.
T. Green & Sons, Ltd.—Economiser, £104.
Holdsworth & Sons.—Lancashire boiler, £368.

The total amount of the tenders is £4,303.

Burnley.—The E.C. has accepted Messrs. Siemens Bros.' tender to supply 1,900 yards of ·1 square inch cable and 950 yards of ·05 square inch cable; also that of a firm for the supply of two mechanical stokers.

Dundee.—The contract for the lighting by electricity of St. Leonard's School Laboratory, St. Andrews, has been secured by Messrs. Maxwell (Dundee), Ltd.

Glasgow.—The Corporation Tramways Committee has recommended the acceptance of the following tenders:—

Single core lead-covered cable.—Standard Cable Manufacturing Co., Ltd.
36-in. copper rail bonds.—U.S. Steel Products Export Co.
Lead-covered and armoured cable.—British Insulated and Helsby Cables, Ltd.

Mansfield.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for water softening plant for the electricity works, at £220.

Nelson.—Messrs. James Batty & Co., of Burnley, have received the contract for lighting and ventilating work at the new Palace Theatre and Hippodrome now being built in Nelson.

Pontypridd.—The following is a list of the tenders received by the electric lighting and tramways department (Mr. J. E. Teasdel, engineer and manager), for one 500-KW. combined generator, consisting of one 720-B.H.P. engine, together with one 350-KW. and 150-KW. dynamos:—

	Engine.	Dynamo.	£
Brush Elec. Eng. Co.	Brush	Brush	2,824
Phœnix Dynamo Co.	Belliss	Phœnix	2,873
Browett, Lindley & Co.	Browett	Bruce Peebles	2,893
Siemens (accepted)	**Belliss**	**Siemens**	2,894
J. Howden & Co.	Howden	Brit. Elec. Plant	2,908
Browett, Lindley & Co.	Browett	Siemens	2,913
Elec. Construction Co.	Belliss	E.C.C.	2,913
J. Howden & Co.	Howden	Bruce Peebles	2,919
Rees Roturbo	Belliss	Rees Roturbo	2,928
Bruce Peebles & Co.	Belliss	Bruce Peebles	2,936
Browett, Lindley & Co.	Browett	E.C.C.	2,955
Brit. Elec. Plant Co.	Belliss	Brit. Elec. Plant	2,955
Browett, Lindley & Co.	Browett	Lanc. D. & M.	2,968
J. Howden & Co.	Howden	Westinghouse	2,980
Lanc. Dynamo and Motor Co.	Belliss	Lanc. D. & M.	2,991
Brit. Thomson-Houston Co.	Belliss	B.T.-H.	2,998
Brit. Elec. Plant Co.	Howden	Brit. Elec. Plant	3,000
J. Howden & Co.	Howden	Lanc. D. & M.	3,025
General Electric Co.	Belliss	G.E.C.	3,029
British Westinghouse	Belliss	Westinghouse	3,042
Siemens	Howden	Siemens	3,045
Siemens	Browett	Siemens	3,061
J. Howden & Co.	Howden	E.C.C.	3,061
Bruce Peebles & Co.	Browett	Bruce Peebles	3,085
British Westinghouse	Allen	Westinghouse	3,119
General Electric Co.	Allen	G.E.C.	3,124
J. Howden & Co.	Howden	G.E.C.	3,139
British Westinghouse	Howden	Westinghouse	3,145
General Electric Co.	Howden	G.E.C.	3,188
British Westinghouse	Browett	Westinghouse	3,190
General Electric Co.	Browett	G.E.C.	3,302
Dick, Kerr & Co.	Belliss	Dick, Kerr	3,311
J. H. Holmes & Co.	Belliss	J. H. Holmes	3,429

The tenders for independent surface condensing plant (including £100 for contingencies) were:—

Worthington Pump Co. (accepted)	£1,550	John Thompson	£1,771
Midland Engineering Co. ..	1,570	Mirrlees Watson Co.	1,803
Brush Elec. Eng. Co.	1,579	Belliss & Morcom	1,903
W. H. Allen, Son & Co.	1,610	R. J. Mitchell	1,930
Isaac Storey	1,626	British Westinghouse Co. ..	2,031
Willans & Robinson	1,662	Richardsons, Westgarth & Co.	2,076
Cole, Marchent & Morley ..	1,721	Loe, Howl & Co.	2,078

Rochdale.—The T.C. has accepted the tender of the Lorain Co., of Johnstown, Penn., for points and crossings for the tramways, at £422.

Swansea.—The Education Committee has accepted the tender of Messrs. Mills, English & Co., Ltd., Swansea, for electric light fittings, &c., for the Technical College extensions, at £375.

York.—The Tramways Committee has accepted the tender of the British Thomson-Houston Co., Ltd., at a cost of £10,914, in connection with the tramways reconstruction. It has been decided to cease running the horse cars this week, and to substitute 'buses, in order not to impede the work of electrification.

NOTES.

Municipal Tramways' Association: Annual Conference.—The eighth annual Conference of this Association is to be held in London at the County Hall, Spring Gardens, S.W., on September 22nd, 23rd and 24th. Mr. A. L. C. Fell will deliver the presidential address. Following this there will be papers and other arrangements as follows:—

Wednesday, September 22nd.—
"Medical Examination of Tramway Employés," by Councillor A. W. Chapman, vice-chairman of Manchester Tramway Committee.
Luncheon at the Trocadero at the invitation of the chairman of the L.C.C.
"The Central Repair Depôt of the London County Council," by Mr. W. E. Ireland, rolling stock superintendent, L.C.C. tramways.
Association Dinner at the Garden Club, White City, at 7.30 p.m.

Thursday, September 23rd.—
"Some Comparisons of Continental and British Methods of Operating Tramways," by Mr. A. R. Fearnley, general manager, Sheffield Corporation tramways.
"Current Consumption," by Mr. R. S. Pitcher, general manager, Aberdeen Corporation Tramways.
Luncheon at the Holborn Restaurant at the invitation of the Highways Committee.
Visit to Central Repair Depôt, and Greenwich generating station, followed by tea provided by the President.
Reception at Mansion House, by the Lord Mayor of London, at 9 p.m.

Friday, September 24th.
Business Meeting, followed by an excursion to Windsor.
The Waldorf Hotel is to be the headquarters of the Association during the Conference. Mr. A. R. Fearnley is secretary of the Association.

Electric Lift Fatality.—At Warrington on August 25th an inquest was held into the death of William Taylor, 26, a shopman at the Co-operative Stores. It appeared that Taylor was unloading an electric lift, when he set it in motion apparently intending to raise it 2 or 3 ft. It, however, continued rising, and dragged deceased with it, crushing him between it and the ceiling. It was suggested, says the *Manchester Daily Guardian*, that the starting button, or "plunger," was defective, and that it was apt to stick. Thomas Hardman, who was working with Taylor at the time of the accident, admitted that it had been sticking on and off for a month, but that no formal report had been made to the management. The shop manager knew of the defect, but understood that it was not material. The chief electrical engineer of the Stores said that Taylor disobeyed instructions in starting the lift from the outside. Had it been started from the inside with the gates properly closed it would have been impossible for the accident to occurr. The Coroner's officer said that he examined the "plunger" an hour after the accident and found that it was rusty and that it stuck. The jury found a verdict of accidental death, and attached no blame to the Society or its officials. They, however, recommended that the "plunger" should be encased in a non-corrosive box and that there should be periodical examinations of it. It would be preferable to provide automatic safeguards, which would render it impossible to start the lift with the gates open.

Breakdown at Niagara.—One of the new 10,000-H.P. turbines in power house No. 3 of the Niagara Falls Hydraulic Power and Manufacturing Co. broke down recently, and two employés were injured. The casing burst, and a piece of metal was hurled across the station, which was partly flooded with the outrush of water. At the time the wheel was moving under about 75 lb. pressure, but has withstood much higher pressure. A defect in the casting is suspected as being the cause of the break.—*Power.*

Lecture Notes.—On August 23rd, at the South-Eastern Agricultural College, Mr. E. Kilburn Scott delivered a lecture on the application of electric power to the manufacture of manures and for expediting plant growth by high-tension discharge. The audience included the staff and about 90 schoolmasters of Kent and Surrey, resident at the college. Mr. Kilburn Scott first referred to the prophecy of Sir William Crookes in 1898, that a time would arrive during this century when the output of sulphate of ammonia from gas works and coke ovens, plus the natural deposits of guano and of sodium nitrate from Chile and Peru, would fall short of that necessary to keep up the supply of the world's wheat, &c. He then described the manufacture of calcium nitrate and calcium cyanamide. Both the above manures have the advantage over sodium nitrate of depositing lime in the soil when they give up their nitrogen. They are, therefore, very good for clayey, sandy, and such other soils as are naturally short of lime. The concluding part of the lecture dealt with the high-tension discharge experiments which for the past two years have been carried on near Gloucester. Mr. Kilburn Scott's lecture was somewhat similar to one he delivered last year at the leading Agricultural College in Australia, whilst he was head of the Electrical Engineering Department at the University of Sydney, New South Wales.

Appointment Vacant.—The Swinton and Pendlebury Electricity Committee has decided to appoint its own electrical engineer for the management of the electricity undertaking. Hitherto the management has been in the hands of the Lancs. Electric Power Co., to which the Council has paid £150 per annum.

Electrical Fatality.—The *Daily News* says that John Dent Thompson, a miner, of Sheldon, employed at a colliery electric pump, on Tuesday took hold of a live wire with his naked hand, and was instantly killed.

Parliamentary.—Third Reading.—In the House of Commons last week the Telegraph (Arbitration) Bill was read a third time.

El Dorado.—The Llandilo Council received 400 applications for particulars of the post of electrical engineer recently advertised; 216 sent in formal applications. The E.L. Committee selected six for the Council's consideration. The salary is to be from £100 to £130, and the age between 25 and 45.

Sequel to an Electric Train Accident.—At the Lancaster County Court on Friday, Judge Hans Hamilton heard an action against the Midland Railway Co. arising out of an electric train accident on the Lancaster and Morecambe line on June 18th, when a landau and horse belonging to Henry Needham, of Morecambe (the plaintiff), were cut up. The damages claimed were £40. It was urged that the company were guilty of negligence through their servants in not giving sufficient warning of the approach of the train at the level crossing where the accident happened, and in leaving the crossing in charge of a woman, who did not open the gates when requested. In the course of the hearing, Motorman Woodhouse said he sounded his hooter repeatedly, and the driver of the vehicle never looked up. The line was straight for nearly 2 miles.—His Honour found there had been contributory negligence on the part of the driver of the landau, and non-suited the plaintiff. He added that the motorman did all he could to avoid the accident.

Sheffield Electrical Department.—The following motion was down on the agenda for Wednesday's meeting of the Sheffield Corporation:—
"That it be an instruction to any Committee of the Council (including the Education Committee) requiring work done by an electrician not to apply for or accept any tender for such work—but that the same be entrusted to the electric department of the Corporation; which department is hereby instructed to execute such work at the actual net cost thereof with an addition of 5 per cent. to cover standing charges."

The Overcrowded Profession?—It is reported in the Press that the Shoreditch Board of Guardians has given the appointment of assistant relieving officer to "Mr. H. L. White, an electrician," son of the Board's chairman.

Educational.—Glasgow and West of Scotland Technical College.—The Calendar for 1909-10 has come to hand, and gives the usual particulars relating to the courses of instruction; the new session opens on the 23rd inst., and the third section of the new buildings will be brought into use.

Northampton Polytechnic Institute.—We have received a copy of the "Announcements" for 1909-10, a volume which yearly increases in size, and gives particulars not only of the educational but also of the many social features of the Institute. Besides the usual technological courses, the Institute provides special instruction in technical optics and horology. The head of the electrical engineering department is Dr. R. Mullineux Walmsley, principal of the Institute, with whom is associated Dr. C. V. Drysdale; Mr. A. C. Jolley is the senior demonstrator and lecturer. Special lectures are given by Mr. H. M. Hobart (Electrical Engineering Design), Dr. J. Erskine-Murray (Radio-Telegraphy), Mr. J. H. Stephens (Submarine Cable Work), Mr. W. H. Winny (Applied Electricity) and Mr. E. K. Scott (Quantities and Estimates), and there are special classes for postal telegraph officers, conducted by Mr. A. W. Martin, with four assistants. A course in Electrochemistry has been organised, and a new departure has been made

in the addition of a class in Aeronautical Engineering. It will be seen, therefore, that the Institute is in close touch with present-day practice. The volume gives full particulars of the courses of instruction, with illustrations of the laboratories. Evening work begins on the 27th inst., and day work on October 4th. The new building is now in use, providing much-needed accommodation for the enlargement of the engineering laboratories.

Manchester Municipal School of Technology.—The calendar for session 1909-10 has been issued, and forms a bulky volume of over 500 pages; an abridged calendar of 20 pages is also issued. The new session opens on the 20th inst.; Prof. Schwartz is the head of the Physics and Electrical Engineering Department, and among his staff are Messrs. C. F. Smith and W. Cramp. Prof. W. W. Haldane Gee is Professor of Pure and Applied Physics. Excellent half-tone illustrations are given of the laboratories, which are admirably equipped, with very full details of the numerous courses provided.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Longton T.C. has increased the salary of Mr. W. Langford, manager of the gas and electricity works, from £500 to £550 per annum.

Mr. C. Furness, borough electrical engineer at Blackpool, who underwent an operation on August 28th, is making satisfactory progress towards recovery.

The Sydney City Council has confirmed the appointment of Mr. E. J. Cochbane, A.I.E.E., of Ballarat (V.), as chief assistant to Mr. H. R. Forbes Mackay, city electrical engineer, at £500, rising to £600 per annum.

On Friday, August 27th, at the Tiger Hotel, Pontmorlais, Mr. A. J. Howard, chief assistant engineer to the Merthyr Electric Traction and Lighting Co., Ltd., was presented by the staff and employés with a portmanteau, writing case and Dawson's "Electric Traction Pocket-Book," on the occasion of his leaving, after 2½ years' service with the company. Mr. Lewis W. Dixon, managing engineer, made the presentation.

The Hove Town Council has received the resignation of Mr. G. M. Harris of his post as resident electrical engineer to the Aldrington electric lighting undertaking, in consequence of ill-health.

Tramway Officials.—Mr. W. W. Webster, chief inspector of the Burton-on-Trent and Ashby Light Railway, has been appointed instructor to motormen by the Bournemouth T.C.

Mr. Daniel Fisher, son of the manager of the Dundee Corporation Tramways, has been appointed manager of the Dundee, Broughty Ferry and District Tramway Co., Ltd., in succession to Mr. J. H. Shepherd.

General.—We have much pleasure in announcing that Mr. T. Mather, Wh.Sch., F.R.S., has been appointed Professor of Electrical Engineering at the Central Technical College, S.W., in succession to the late Prof. W. E. Ayrton. The appointment will give great satisfaction to Prof. Mather's numerous friends, especially to the army of "old students," who regard their association with him in their college days as one of their most valued privileges. Mr. Mather for many years held the post of chief assistant in the Electrical Engineering Department, and is a member of the Faculty of Engineering of the University of London, as well as of the Board of Examiners and Board of Studies in Electrical Engineering of the University, and Member of Council of the Institution of Electrical Engineers, and of the Physical Society. Of his numerous inventions many are in every-day use in electrical works and laboratories, and his scientific papers, many of which were prepared in collaboration with Prof. Ayrton, have made his name familiar to the electrical engineer; in particular the Ayrton-Mather moving-coil galvanometer, electrostatic voltmeters, non-inductive resistances, and universal shunt may be mentioned as especially noteworthy. Under Mr. Mather's immediate supervision the electrical engineering department at the College has been reorganised and extended during recent years, and is able to hold its own with any of the admirably equipped laboratories which have been organised in our great cities, modelled largely on the pattern of the C.T.C. Mr. G. W. O. Howe, Wh. Sch., M.Sc., who was formerly for several years with Messrs. Siemens Bros. & Co., and Messrs. Siemens and Halske, of Charlottenburg, and has been chief lecturer and demonstrator at the C.T.C. since 1905, has been appointed Assistant Professor of Electrical Engineering at the Central Technical College; we have pleasure in offering our congratulations to both parties.

Mr. G. H. C. Risch, M.I.E.E., who has had an exceptionally varied and thorough electrical engineering experience extending over more than 20 years, and who for eight years held the position of chief electrical engineer for the Transvaal and Orange River Colony Railways, is now in England. We understand that he is here with a view to entering upon a new appointment when opportunity arises.

The *Times* announces that Major C. G. Burnaby, R.E., now serving at Falmouth, has been appointed Chief Instructor at the School of Electric Lighting, Plymouth, in place of Major St. G. R. Caulfeild, whose appointment has expired.

We are asked to state that the note in our last issue respecting Mr. Rankin's appointment does not refer to the Electrical Co., Ltd. (A.E.G., Berlin), Manchester.

We regret to learn from our trans-Atlantic contemporaries of the sudden death of Mr. A. A. Knudson, a well-known New York consulting engineer and expert on electrolysis. Mr. Knudson was a very frequent contributor to the Press on the subject mentioned.

Mr. R. W. Hogarth, of 16, Rutland Square, Edinburgh, whose late partner, Mr. Buchan, recently died, has made arrangements with Mr. C. S. Vesey Brown, M.Inst.C.E., and Mr. Wilfred Hall, A.M.Inst.C.E., for carrying on with them practice as consulting electrical and mechanical engineers at the above address, and also at Newcastle and in London, under the firm name of Buchan and Partners.

On September 3rd, at Turnham Green, the marriage took place of Percy, eldest son of Mr. S. Alfred Varley, of dynamo fame, to Violet, daughter of the late J. E. Bloom. The Rev. Telford Varley, M.A., brother of the bridegroom, performed the ceremony.

The Sunderland Education Committee has decided to appoint Mr. W. T. MacCall, M.Sc., of Halifax, head of the Electrical Engineering Department at the Sunderland Technical College.

Mr. Horace H. Leage, A.M.I.E.E., announces that he is giving up his address at 10, City Road, London, E.C., having taken an appointment with Messrs. A. W. Pocklington & Co., 47, York Street, Westminster.

Mr. William Murray, of the firm of Williamson, Murray and Co., has joined the board of the Edison & Swan United Electric Light Co., Ltd.

On Saturday last the electrical staff of the Frodingham Iron and Steel Co., Ltd., made a presentation to Mr. A. G. Cutts, who is leaving to take up the position of chief electrical engineer to the Leeds Copper Works, Ltd.

Obituary.—The death is announced from Sydney of Mr. D. Kirkcaldie, assistant commissioner of the New South Railways.

NEW COMPANIES REGISTERED.

Prestwich & Burt, Ltd. (104,596).—This company was registered on August 16th, with a capital of £1,500 in £1 shares, to acquire the interest of E. C. Lea in the business carried on by him at South Lane, Kingston-on-Thames, as Prestwich & Burt, and to carry on the business of manufacturing electricians, electrical and mechanical engineers and contractors, founders, dealers in electrical accesories, &c. The subscribers (with 450 shares each) are:—A. Vandam, 17, Evelyn Mansions, Carlisle Place, S.W., electrical engineer; C. Zee, 17, Evelyn Mansions, Carlisle Place, S.W., electrical engineer. Private company. The number of directors is to be three: the first are A. Vandam, C. Zee and C. Lea (all permanent, subject to holding 450 ordinary shares). C. Zee is the first secretary. Table "A" mainly applies. Registered by William Hurd & Son, 25, Bucklersbury, E.C.

Bowers & Barr, Ltd. (104,680).—This company was registered on August 23rd, with a capital of £2,000 in £1 shares, to take over the business of electrical engineers carried on by F. C. Bowers and E. V. Barr, as "Bowers and Barr," at Great Yarmouth. The subscribers (with 100 shares each) are:—F. C. Bowers, 134, Lichfield Road, Great Yarmouth, electrical engineer; O. A. Hubbard, Northfield, North Walsham Road, Norwich, electrician. Private company. Table "A" mainly applies. Registered by Ferrier & Ferrier, 33, Hall Plain, Great Yarmouth.

International Electric Transport and Enterprise Co., of Alsace-Lorraine, Ltd. (104,668).—This company was registered on August 21st, with a capital of £200,000 in 195,000 preferred shares of £1 each and 100,000 deferred shares of 1s. each, to undertake and develop electric carriage and other enterprises in Alsace-Lorraine and elsewhere, and to carry on the business of constructors of electric tramways and railways, motor-vehicles, tunnels, bridges and roads, carriers of passengers and goods, &c. The subscribers (with one preference share each) are:—K. S. Thompson, Farnaby, Sevenoaks, solicitor; E. T. Wheeler, 47, Durlston Road, Upper Clapton, N.E., accountant; F. H. Fletcher, 3, East India Avenue, E.C., solicitor; A. Molock, 3, East India Avenue, E.C., secretary; F. J. Allen, 3, East India Avenue, E.C., secretary; A. F. Argles, St. Stephen's House, Victoria Embankment, S.W., surveyor; W. H. Quarrell, 3, East India Avenue, E.C., solicitor. Minimum cash subscription, £2,000. The number of directors is not to be less than two or more than eleven; the first are C. Simon and A. Santier (both of Guebwiller, Alsace, Germany) and A. F. Argles; qualification, £100; each director is to receive £1 per board meeting attended, in addition to travelling and hotel expenses, and also £4 per day "during absence from place of residence"; directors and managing director also to be entitled to a fixed remuneration, to be decided on by the board. Registered office, 3, East India Avenue, E.C.

E.M.F., Ltd. (104,699).—This company was registered on August 24th, with a capital of £20,000 in £1 shares, to adopt an agreement with J. M. Bein, A. J. Grose, T. H. Satchwell and O. H. Bishop, and to carry on the business of electricians, mechanical and electrical engineers, suppliers of electricity for light, heat, motive power, or other purposes, &c. The subscribers (with one share each) are:—J. M. Bein, 103, Muswell Avenue, Muswell Hill, N., electrical engineer; A. J. Grose, 14, Ashchurch Grove, Shepherd's Bush, W., gentleman; O. H. Bishop, 7, Layer Gardens, West Acton, W., electrical engineer. Private company. The number of directors is not to be less than three or more than five; the first are J. M. Bein, A. J. Grose and O. H. Bishop; remuneration of J. M. Bein and A. J. Grose, £450 per annum; of O. H. Bishop, £500 per annum. Registered by Barfield & Barfield, 47, Finsbury Square, E.C.

Bullivant's South African Co., Ltd. (104,728).—This company was registered on August 26th, with a capital of £5,000 in £1 shares, to carry on in South Africa and elsewhere the business of dealers in wire rope and netting, torpedo defence nets, wire tramways, mining and hauling plant, telegraph cables, and all apparatus and appliances connected therewith. The subscribers (with one share each) are:—W. P. Bullivant, 72, Mark Lane, E.C., wire rope manufacturer; F. A. Bullivant, 72, Mark Lade, E.C., wire rope manufacturer; P. J. Bullivant, 72, Mark Lane, E.C., wire rope manufacturer; B. S. Bullivant, 72, Mark Lane, E.C., wire rope manufacturer. Private company. The number of directors is not to be less than two or more than four: The first are W. P. Bullivant, F. A. Bullivant, P. J. Bullivant and B. S. Bullivant. Registered office, 72, Mark Lane, E.C.

Plutte, Scheele & Co., Ltd. (104,840).—This company was registered on September 3rd, with a capital of £6,600 in £1 shares, to adopt an agreement with F. Plutte for the acquisition of the business of Plutte, Scheele and Co., and to carry on the business of manufacturers of and sellers of articles and accessories required in the electrical and allied trades, &c. The subscribers (with one share each) are:—J. N. Cooper, 18, 19, Queenhithe, E.C., electrical engineer; P. Kuppers, 18, 19, Queenhithe, E.C., merchant. Private company. The number of directors is not to be less than two or more than five; the first are J. N. Cooper and P. Kuppers; remuneration as fixed by the company. Registered office, 18 and 19, Queenhithe, E.C.

National Lighting Corporation, Ltd. (104,783).—This company was registered on August 30th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, manufacturers of and dealers in electric lights and electrical appliances and novelties, &c. The subscribers are:—A. Lange, 93, Aldersgate Street, E.C., merchant, two shares; I. Frohwein, 93, Aldersgate Street, E.C., merchant, one share; S. Mundler, 35, Cock Lane, Snow Hill, E.C., business manager, one share. Private company. The number of directors is not to be less than two or more than five: the first are A. Lange, I. Frohwein and S. Mundler; qualification (except managing director), £100; remuneration, one guinea each per board or general meeting attended. Registered office, 35, Cock Lane, Snow Hill, E.C.

OFFICIAL OF RETURNS ELECTRICAL COMPANIES.

Llandudno and Colwyn Bay Electric Railway, Ltd. (89,639).—Trust deed dated July 27th, 1909, to secure £75,000 1st mortgage debentures, charged on the railway undertaking authorised by the Llandudno and Colwyn Bay Light Railway Orders 1898 to 1907, and the company's general assets, present and future. Holders: Trustees, Executors and Securities Insurance Corporation, Ltd., Winchester House, Old Broad Street, E.C.

A memorandum of satisfaction in full on July 27th, 1909, of debentures dated March 11th, 1909, securing £50,000, has been filed.

Kent Electric Power Syndicate, Ltd. (72,742).—Debenture for £1,038, dated August 5th, 1909, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Kent Electric Power Co., Strood.

Memoranda of satisfaction (*a*) in full on November 8th, 1905, of charge dated February 14th, 1905, securing £4,275, (*b*) to the extent of £1,500 on July 24th, 1908, of charge dated May 26th, 1905, securing £1,800, and (*c*) in full on August 13th, 1906, of charge dated July 3rd, 1905, securing £750, also notified on August 1st, 1909.

"Z" Electric Lamp Manufacturing Co., Ltd. (96,594).—Charge under Land Transfer Acts, dated August 11th, 1909, to secure £25,000, charged on freehold land and buildings at Southfields, S.W. Holders: J. G. B. Stone, 9, Draper's Gardens, E.C.; and J. Venning, 5, Gray's Inn Square, W.C.

Chipperfield Lamp Syndicate, Ltd. (98,008).—Issue on August 13th, of £60 debentures, part of a series of which particulars have already been filed.

CITY NOTES.

British Thomson-Houston Co, Ltd.

The report of the directors to be submitted to the meeting to be held at 83, Cannon Street, E.C., on September 14th, covers a period of 12 months from April 1st, 1908, to March 31st, 1909. It reads as follows:—

Works at Rugby.—The buildings and machinery of the company have been maintained in first-class condition during the year, and while the directors have not been able to make depreciations, except as hereinafter mentioned, they have made a number of improvements and additions, the most important being the extension of the steam plant, at a cost of £8,766. They have also followed their usual practice of making reserves to cover risks in connection with bad debts, depreciation of shares held by the company, and for other contingencies.

Curtis Steam Turbines.—As stated in the last annual report, the company now owns all the patents for the United Kingdom for Curtis steam turbines, excepting the marine rights. During the financial year the company sold 12 turbines aggregating 15,000 KW., and the directors feel confident that the business of the company in steam turbines will be large, due not only to the unrivalled excellence of the company's apparatus, but also to the unique fact that the company can supply either the vertical or the horizontal type, whichever is best suited to each installation. In this connection it is interesting to note that since the end of the year under review the company has sold 18 turbines, aggregating 18,569 KW.

Industrial Developments.—The volume of business in this direction during the year has not been satisfactory, due to the depressed condition of trade generally, yet a large number of important contracts have been secured, and marked progress has been made.

Central Station Developments.—The most important contracts have been for turbines, the sales of which are referred to above.

Traction Work.—The quantity of electrical equipment for tramway and railway work sold in Great Britain during the year has been very small, but the company has received its fair share of this business.

Switchboards.—The company has closed several important contracts for switchboards during the year.

Metallic-Filament Lamps.—The company has made further satisfactory progress in the development of metallic-filament (tungsten) lamps, and, to meet the increasing demand, is extending its manufacturing facilities.

Debenture Redemption.—Under the terms of the trust deed securing the issue of the company's debentures, the company had to pay to the trustees on February 28th last the sum of £3,339, to be applied by them in purchasing debentures in the market. Debentures of the par value of £3,500 were purchased prior to March 31st (the end of the year under review), making the total par value of debentures retired to date £7,060.

The directors regret that the balance-sheet shows a loss of £825 as the result of the year's working, after paying interest on debentures and on loans. They deem it wise, however, to write off certain items, and to that end have carried into the profit and loss account the balance brought forward from last year—viz., £2,467 and the reserve of £15,409, which have been applied as shown in the profit and loss statement. Mr. J. F. Nauheim has been elected chairman of the company.

United Electric Car Co., Ltd., Preston.

The directors' report for the year ending June 30th, 1909, states that the works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,500, and charging £5,646 for depreciation, the profit for the year is £8,896, to which is added £6,187 brought from last year, making a total of £15,083. After deducting preference dividend for the six months ending December 31st, 1908, £3,000, there is an available balance of £12,083. The directors recommend that this amount be dealt with as follows:—Preference dividend, less income-tax, for the half-year ending June 30th, 1909, £3,000, a dividend of 2½ per cent., less income-tax, on the ordinary shares for the year ending June 30th, 1909, £3,750, carrying forward to next year £5,333.

The meeting is to be held at Preston on September 15th.

Sao Paulo Tramway, Light and Power Co., Ltd.—A quarterly dividend of 2½ per cent. on the capital stock has been declared, payable on October 1st.

Canadian General Electric Co.—The directors have declared a dividend of 1¾ per cent. on the common stock for the three months to 30th inst., being at the rate of 7 per cent. per annum.

British Columbia Electric Railway Co., Ltd.—The directors have announced to shareholders their intention to make a further issue of £500,000 of capital offering same to the preferred and deferred ordinary stockholders. The new capital will take the form of 5 per cent. cumulative preference shares (200,000 of £1 each at 1s. premium), 5 per cent. non-cumulative preferred ordinary (200,000 of £1 each at 2s. premium), and deferred ordinary (100,000 of £1 each at 3s. premium). The new capital is required to keep pace with the rapidly increasing business in every department.

Ibbotson Bros. & Co., Ltd.—The thirty-seventh annual report states that the profit for the year ended June 30th amounts to £23,154, to which has to be added £10,492 brought forward. The directors recommend that a final dividend be paid of 6s. per share, tax free, making 10 per cent. for the year, that £3,000 be added to the reserve fund, and that the balance of £11,116 be carried forward.

Germany.—The balance-sheet of the Hamburgische Electricitätswerke Gesellschaft, of Hamburg, for the last financial year shows a net profit of £100,349 as contrasted with £100,647 in the preceding 12 months. A dividend at the rate of 8 per cent. is again being declared.

Doulton & Co., Ltd.—The directors announce (says a financial daily) that they are advised that the trading of the past six months does not warrant the declaration of an interim dividend on the preference shares.

Globe Telegraph and Trust Co., Ltd.—The directors have declared a dividend of 2s. each on the ordinary shares.

Dundee and Broughty Ferry Tramway Co.—The directors' report states that the profit (including sum brought forward from last year) amounts to £4,512. From this there falls to be deducted interim dividend paid on 6 per cent. preference shares on February 1st last, £1,500, leaving a balance of £3,012. The directors recommend the disposal of this sum as follows:—(1) To pay final dividend on 6 per cent. preference shares, £1,500; (2) to renewals fund, £300; (3) to fund for redemption of debenture stock, £600; and (4) to carry forward to next account, subject to remuneration of managing director for part of year, £312. The total earnings for the year amounted to £12,835, an increase of £227 over last year.

Prospectuses.—*Krubong (Malacca) Rubber Plantations, Ltd.*—There has been offered this week an issue of 13,666 shares of £1 each in this company.

Batu Kawan Rubber and Coconut Plantations, Ltd.—This company, operating in the Straits Settlement, is offering 42,500 shares of £1 each for subscription.

The Ivory Coast Rubber Estates, Ltd.—An issue of 50,000 shares of £1 each was offered for subscription last week. The company is to purchase two concessions granted by the Government of the Ivory Coast Colony of West Africa.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Sept. 1	3,179	+ 86	13	20,948	— 600	..	..
Ayr	,, 4	731	+ 83	16	6,543	— 193	8	..
Bath	,, 1	1,810	+ 202	35	27,2?9	+ 1,229	..	..
Belfast	,, 3	7,409	+ 238	21	86,436	+ 3,827	37	..
Birkenhead	,, 5	2,222	+ 66	22	24,549	— 375	13·63	..
Birmingham Corp.	Aug. 28	12,946	+ 290	22	141,693	+ 3,727	..	..
Blackburn	Sept. 1	1,070	— 116	23	26,052	— 988	13·97	..
Blackpool-Fleetw'd	,, 4	3,005	+ 509	9	14,488	+ 699	..	..
Bolton	,, 5	4,698	+ 215	23	54,228	— 575	42	..
Bournemouth	,, 1	4,494	+ 146	22	40,462	+ 265	21·96	..
Bradford	,, 4	9,860	+ 539	22	113,580	+ 2,477	54·9	..
Brighton	,, 6	2,510	+ 314	28	24,423	+ 1,119	9·5	..
Bristol	,, 8	11,712	+1,735	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Aug. 27	473	+ 15	34	7,411	— 100	3·65	..
Barnsley	,, 27	415	— 47	,,	5,745	— 316	..	..
Barrow	,, 27	534	— 46	,,	7,904	— 606	5·37	..
Cavehill	,, 27	289	+ 17	,,	3,059	— 197	..	..
Devonport	,, 27	768	— 224	,,	12,597	— 3,071	8·85	..
Gateshead	,, 27	2,334	+ 15	,,	33,885	— 295	11·25	..
Gravesend	,, 27	499	— 32	,,	7,132	— 139	6·5	..
Greenock	,, 27	1,351	+ 129	,,	18,749	+ 526	7·25	..
Hartlepool	,, 27	571	— 19	,,	8,017	— 223	6·72	..
Kidderminster	,, 27	279	+ 14	,,	3,755	— 221	..	..
Leamington	,, 27	418	+ 9	,,	5,977	+ 182	..	..
Merthyr	,, 27	445	+ 18	,,	7,320	+ 103	2·9	..
Metropolitan	,, 27	13,479	+1,522	,,	209,768	+16,535	22	..
Middleton	,, 27	812	— 67	,,	11,628	— 949	8·5	..
Mid. Joint Com'tee	,, 27	11,550	+ 197	,,	193,687	— 2,270	..	..
Oldham—Ashton	,, 27	1,211	— 84	,,	19,106	— 1,318	9·13	..
Peterborough	,, 27	189	+ 6	,,	4,042	— 330	5·81	..
Potteries	,, 27	3,461	+ 135	,,	60,064	— 1,284	29	..
Rothesay	,, 27	1,179	+ 72	,,	8,039	— 129	2·75	..
Southport	,, 27	738	— 27	,,	10,075	— 311	8·17	..
S. Metropolitan	,, 27	1,937	+ 195	,,	27,228	— 894	..	..
Swansea	,, 27	2,193	+ 110	,,	32,825	+ 575	12·5	..
Tynemouth	,, 27	907	+ 152	,,	8,780	+ 564	3·75	..
Weston-s-Mare	,, 27	900	+ 48	,,	5,581	+ 264	3	..
‡Worcester	,, 27	671	+ 19	,,	9,555	— 70	5·75	..
Wrexham	,, 27	225	— 5	,,	3,336	— 148	..	..
Yorks. Wool. Dist.	,, 27	1,998	+ 85	,,	30,860	— 383	17	..
Miscellaneous	,, 27	533	+ 55	,,	7,155	+ 124	..	..
Burnley	Sept. 4	2,522	+ 139	..	..	..	..	..
Burton-on-Trent	,, 5	547	— 23	23	6,208	— 170	6·63	..
Bury	Aug. 29	2·3 5	— 3	21½	26,084	— 593	23·6	..
Cardiff	,, 28	4,581	+ 126	22	49,548	+ 4·8	..	..
Carlisle	Sept. 3	864	— 80	35	5,859	— 244	..	..
Chatham and Dist.	,, 2	1,929	+ 207	35	28,700	+ 1,690	14·98	..
Cork	,, 2	1,009	+ 44	35	15,482	— 767	..	..
†Croydon	Aug. 27	3,342	+ 676	..	33,355	+ 1,220	11·25	4·75
†Darlington	,, 28	197	— 15	22	4,133	— 276	..	..
Darwen	Sept. 4	488	— 7	22	5,654	— 228	4·86	..
†Dover	Aug. 28	671	+ 95	23	4,990	— 381	4·75	..
Dublin	Sept. 3	12,670	+ 829	..	56,628	+ 1,235	54·25	..
Dundee	,, 1	2,685	+ 126	15½	18,899	— 422	15	..
East Ham	,, 4	1,964	+ 356	22½	23,119	+ 3,210	8 43	·68
Exeter	..	..	..	..	..	..	..	..
Glasgow	,, 4	33,863	+ 145	..	230,572	— 3,818	90·6	1·5
Hastings	,, 2	3,068	+ 171	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
†Hull	Aug. 28	2,571	+ 214	21	51,333	+ 1,433	14 5	1·5
Ilkeston	Sept. 1	303	— 3	22	3,068	— 194	..	..
Ipswich	,, 4	999	+ 93	23	9,787	+ 143	10·5	..
Kilmarnock	,, 4	283	— 6	16	2,476	— 88	4·25	..
Lan'kshire Trm. Co.	..	..	..	..	..	..	..	..
Lancashire United	,, 1	2,632	— 301	35	46,615	— 565	..	..
Leeds	Aug. 28	14,027	+ 892	22	149,589	+ 2,391	54	6
Leicester	Sept. 4	4,350	+ 74	..	..	..	..	..
Leith	Aug. 28	1,298	+ 261	15	9,893	+ 1,193	6	..
Liverpool	,, 28	21,830	+ 391	34½	367,376	— 2,375	104	..
†L.C.C.	,, 21	74,707	+4,558	..	747,525	+26,192	121	4·25
London United	Sept. 4	13,684	+ 178	..	216,585	—20,789	..	..
Lowestoft	,, 4	791	— 14	49	10,016	— 1,084	3·5	..
†Manchester	Aug. 28	14,793	+ 340	..	326,238	— 3,463	90·5	6
Newcastle	Sept. 4	7,892	— 43	..	88,190	— 1,160	..	..
†Newport	Aug. 28	681	+ 23	22	14,781	— 309	14·5	..
†Oldham	,, 29	1,985	— 180	23	42,822	— 3,198	28·75	..
Pontypridd	,, 28	802	+ 43	21½	9,155	+ 1,116	5·5	1·75
Portsmouth	..	..	..	..	..	..	..	..
Preston	Sept. 1	1,510	— 12	..	..	..	..	..
Rotherham	,, 2	1,184	— 48	22	13,284	— 593	10	·66
Salford	Aug. 30	8,830	— 118	21½	101,165	— 3,517	..	..
Sheffield	Sept. 5	11,189	+ 344	23½	131,759	— 1,236	57	1·25
Southampton	,, 1	2,424	+ 124	22	24,647	— 421	..	..
Southend-on-Sea	,, 1	1,604	+ 182	22	18,592	+ 2,114	..	..
South Shields	,, 4	1,173	— 12	22?	13,297	+ 10	..	..
†Swindon	,, 1	154	— 3	..	..	..	..	..
Tyneside	,, 1	875	+ 19	9	4,207	+ 222	..	..
Wallasey	Aug. 28	1,959	— 98	21½	21 040	+ 485	..	·22
Walthamstow	Sept. 4	1,418	+ 178	23	15,952	+ 815	9	..
†West Ham	Aug. 19	2,392	+ 193	20	48,457	+ 2,830	15·13	·43
Wolverhampton	Sept. 1	1,533	— 74	22	18,116	— 950	12·5	..
Baker St.-Waterloo	,, 4	5,420	— 215	9	25 995	+ 650	4·25	..
Cen. London Rly.	,, 4	9,244	—4,486	9	44,199	—12,545	6 32	·55
Char. +, Bus. Hamp.	,, 4	6,845	+ 7 0	9	32,690	+ 4,115	7.75	..
City & S. Lon. Rly.	,, 5	5,858	— 89	9	27,321	+ 1,170	7·2	..
Dublin-Lucan Rly.	,, 3	347	+ 49	9	1,561	+ 55	7	..
G.N. and City Rly.	,, 4	2,450	— 26	9	11,128	— 48	3·5	..
G.N., P'y. & Brmin.	,, 4	9,125	— 80	9	43,660	+ 675	9·25	..
L'pool Overh'd Rly.	,, 5	2,802	+ 71	9	14,787	+ 90	6·8	4·8
Llandudno-Col. Bay	,, 3	1,583	+ 145	40	11,984	+ 1,207	..	..
Mersey Railway	,, 4	8,733	+ 61	9	17,146	+ 570	4·5	..
Metropolitan Rly.	,, 5	30,152	— 252	..	140,609	+ 1,665	24·5	..
Met. District Rly.	,, 4	17,698	+ 240	9	84,193	+ 5,600	24	..
Anglo-Argentine	,, 2	97,712	+7,933	..	1,361,409	+84,627	..	..
‖Auckland	..	..	..	..	..	..	..	..
Bombay (B.E.T.)	Aug. 5	4,689	+ 469	31	77,464	+ 4,453	..	..
‖Brisbane	..	..	..	..	..	..	..	..
‖Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Sept. 4	6,330	+ 82	..	..	..	..	..
‖Cape Electric T. Ld.	..	..	..	..	..	..	..	..
‖Kalgoorlie, W.A.	..	..	..	..	..	..	..	..
Madras	Aug. 31	1,409	+ 201	..	20,349	+ 407	..	..
‖Melbourne	..	..	..	..	..	..	..	..
‖Lisbon	..	..	..	..	..	..	..	..
Perth (W.A.)	Sept. 3	2,668	+ 228	..	49,264	+ 232	98	2·4

* Compared with the corresponding period of 1908. † One week only.
‡ Includes horse, steam and other receipts. ‖ One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Holidays are now practically over, and all—or most—of the children have gone back to school, so there is no longer any real excuse for their fathers to be "slack." But in the Stock Exchange, trade cannot be forced beyond a certain, very near, point, and it has still to be acknowledged that business in all except a few favoured securities is as coy as the subject of Sir Walter Scott's famous lines.

One of the few departments in which any state approaching activity obtains is the iron, coal and steel market. Many of the companies, and, indeed, the industry itself, are intimately related to the electrical trade, and the advance in prices will be watched with keen interest. Starting amongst armament shares, the rise in Vickers & Armstrongs has spread to shares in such companies as Babcock & Wilcox, besides those which are more directly connected with the iron and steel business. The movement is the more welcome in that it points to the better conditions of the country's trade, as a whole, having permeated one of the most important classes of industry. Recent advances in shares and stocks such as Henley's, Callender's and Telegraph Construction are fully held.

Yet the state of the Home Railway market is still a very disappointing one, and prices seem quite unable to lift themselves for long together out of the ruck of depression into which they have dropped. The weariness of the market extends even to Metropolitans and Districts, both of which are again on the down grade. However, there is a rise of 2 in the 4½ per cent. bonds of the Underground Electric Railway, thanks to the statement issued the other day, which was accompanied by the intimation that the company will, after this, publish monthly statements of profit. In the dim and distant future, other railways will do the same thing.

British Columbia Electric Railway Deferred and Preferred stocks are *ex* the right to apply for the new issue, and the falls of about five points represent what the rights are worth. Anglo-Argentine Trams are strong. The Second Preference, which are 5 per cent. cumulative shares, gained $\frac{3}{16}$, and the 4 per cent. Debenture stock is ¼ better. Cape Electric Trams dismally dwindle. Mexico Trams are again pursuing their upward course, while Mexican Light and Power has more than recovered its loss of last week. These rallies are due more than anything else to the subsiding of the floods at Monterey, which enabled the power company to resume work and caused the 5 per cent. Debenture stock to regain 3 points, hardening to 89. Of others in the same group, Rio Trams are rather easier at 92, the bonds being steady at 95. Mexico Tramways bonds went *ex* coupon last Wednesday, and at 94½ have attracted buyers who think the security looks cheap again. The Sao Paulo Tramway Company has declared a dividend of 2½ per cent. on its ordinary stock.

Notting Hill shares are the most favoured of the electricity supply list, and at 12¼ they show a further 10s. gain. Brompton and Kensington Ordinary are 2s. 6d. lower, and Folkestone Ordinary lost a similar fraction. No other changes have occurred, so that the despair of the young gentleman who had to write half a column of breezy notes around this trio of movements will be fully appreciated.

Excitement in the American railroad department having cooled to something under fever pitch, the gamble in Anglo-American Telegraph Deferred stock has also simmered down, and the price with it. The decline, however, is insignificant. Eastern Telegraph stock drooped, but lower-priced shares, such as West India and Panama and West Coast of America, are stronger. Great Northern Telegraphs lost their rise of a week ago.

Marconi shares firmed up to 15s., on the announcement that the company had come to an agreement with the Government in connection with certain of its stations which, a few years hence, would have been compulsorily acquired. This is satisfactory, so far as it goes, but it is wholly insufficient ground upon which to advise the purchase of the shares. National Telephone Deferred has again weakened, while a point rise lifted American Telephone and Telegraph capital stock to 147 middle.

Stock Exchange Notice. — The Committee has ordered the undermentioned securities to be quoted in the Official List:—Mexico Tramways Co.—£1,250,000 6 per cent. 50-year mortgage bonds of £100 each, Nos. 1 to 12,500, in lieu of the scrip now quoted.

Davis & Timmins, Ltd.—The directors recommend a 6 per cent. dividend on the preference shares for the six months ended June 30th.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1906.	1907.	1908.	Closing Quotations Aug. 31st.	Closing Quotations Sept. 7th.	Business done week ended Sept. 7th, 1909. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent.
											£ s. d.	
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2¼ — 3⅜	2⅜ — 3⅜	..	..	..	Nil.
126,700	Do. do. 5 % Debs., Nos. 1 to 1,260 Red.	100	5 %	5 %	5 %	5 %	93 — 96	93 — 96	94½	..	..	5 4 2
$121,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	8 %	8 %	8 %	145 —147	144 —146	146	144⅜	..	5 8 10
$50,000,000	Do. Collat. Trust, 4% Bonds, 1 to 25,000 and 50,001 to 75,000	$1000	4 %	4 %	4 %	4 %	96 — 98	97 — 99	..	..	..	4 1 8
558,460	Anglo-American Telegraph	Stock	3½%	3½%	3½%	£3 4s.	60½ — 62½	60½ — 62½	..	..	..	5 3 0
3,220,770	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	6 %	103½ —104½	103½ —104½	104½	103⅞	..	5 14 6
3,220,770	Do. do. do. Deferred	Stock	½%	1½%	1 %	8/-	21 — 21½	20½ — 20⅞	21⅛	21	— ⅜	1 18 4
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	103½ —106½	103½ —105½	..	..	..	4 14 9
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8⅜	8 — 8⅜	..	..	..	4 14 1
2,431,550	Commercial Cable, Sling. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	90½	..	..	4 7 0
16,000	Cuba Telegraph	10	5 %	5 %	6 %	6 %	8¼ — 9	8¼ — 9	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	2⅞ — 3⅜	2⅞ — 3⅜	65/-	..	..	5 8 5
6,000	Do. do. 10 % Cum. Pref. ..	10	10 %	10 %	10 %	10 %	8¼ — 8¾	8¼ — 8¾	..	..	..	5 12 8
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —101	100 —102	..	..	+1	8 16 6
80,710	Direct United States Cable	20	4½%	4½%	4½%	4½%	13 — 13½	13 — 13½	13⅜	13½	..	6 5 11
43,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	129 —132	128 —131	129½	128	—1	5 6 10
2,100,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	84½ — 86½	84½ — 86½	86	85	..	4 0 0
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	104½ —106½	104½ —106½	..	..	..	3 15 2
600,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	7 %	11⅜ — 12⅛	11⅜ — 12⅛	12⅛	11⅞	..	5 14 3
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104	102 —104	104	..	..	3 16 11
200,000	{East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.} 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	10½ — 10⅝	10½ — 10⅝	10⅝	10½	..	5 7 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜ — 14⅛	13⅜ — 14⅛	14⅛	13⅜	..	4 4 3
150,000	Great Northern Telegraph, of Copenhagen ..	10	24%	20 %	20 %	18 %	26½ — 27½	26 — 27	26⅜	..	..	6 13 4
10,000	{Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,000, Red.}	100	4½%	4½%	4½%	4½%	100 —102	100 —102	100	..	..	4 8 3
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	51½ — 53½	51½ — 53½	53	..	..	6 1 6
$41,380,400	Mackay Companies Common	$100	2 %	3½%	4 %	4 %	84 — 86	84 — 86	..	..	..	4 13 0
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	74 — 78	74 — 79	..	..	..	5 2 0
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛ — 1⅜	33/- — 37/-	17/6	15/-	+ 3/32	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	5 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	6 0 7
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..	5 13 3
2 235,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —107⅛	106 —107⅛	107⅛	106⅛	..	5 11 7
3,735,000	Do. do. Def. Stock	100	5 %	5 %	6 %	6 %	122½ —124½	121½ —123½	123	121½	—1	4 17 2
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅝ — 10⅞	10⅝ — 10⅞	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛ — 10⅝	10⅛ — 10⅝	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅛	5⅛ — 5⅛	..	..	..	4 7 3
2 000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	98½	..	..	3 10 0
1,988,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	100½	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	7 %	8 %	8 %	1⅜ — 1½	1⅜ — 1½	..	..	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 16 0
99,100	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87½	86⅜	..	4 11 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
11,889	Reuter's	8	5 %	5 %	5 %	5 %	78 — 83	78 — 83	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100½ —102½	100½ —102½	..	..	..	4 7 10
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	130 —133	130 —133	..	..	..	4 10 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅛ — 7⅜	6¾ — 7⅛	7⅛	6⅛	— ⅛	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½ — 6⅝	5½ — 6⅝	6⅝	..	..	4 8 10
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	2½%	2½%	..	1⅜ — 1⅝	1⅞ — 1⅞	23/7½	21/6	+ 1/16	4 10 10
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	101 —103	103	..	+1	3 17 8
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13½ — 13⅝	13½ — 13⅝	13½	13½	..	5 1 10
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	..	..	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/16 — ⅜	5/16 — 11/16	13/9	11/3	+ 1/16	N
94,563	Do. do. 6 % Cum. 1st Pref.	10	5 %	6 %	6 %	6 %	8 — 8½	8 — 8⅝	8⅝	..	..	7 1 2
4,669	Do.* do. 6 % Cum. 2nd Pref.	10	Nil	Nil	£2 6	15 %	8 — 9	8 — 9	..	..	..	17 2 4
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	{Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000}	5	..	..	..	..	4⅜ — 4⅞	4⅜ — 4⅞	96/3	93/9	..	5 2 4
500,000	Do. 5 % 2nd Pref., 800,001 to 1,800,000	5	..	..	..	..	4⅜ — 4⅝	4⅜ — 4⅛	93/1½	..	+ 3/16	5 8 11
978,250	Do. 4 % Deb. Stock	..	..	..	..	4 %	92½ - 93½	91½—93½	93⅝	92½	+ ½	4 6 6
332,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	103	..	..	4 15 3
580,000	Babcock & Wilcox, 1 to 580,000	1	20 %	20 %	20 %	20 %	4⅝ — 4 7/16	4⅜ — 4½	90/-	89/4½	+ 1/16	4 8 11
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	4 0 0
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	7 %	⅜ — ½	⅜ — ½	18/9	..	..	48 0 0
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	1⅜ — 1⅝	1⅝ — 2⅛	40/3	..	+ ⅛	16 9 4
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	3⅜ — 3⅝	3⅜ — 3⅝	72/6	67/6	..	7 10 11
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	4 %	2½ — 3¼	2½ — 3¼	..	..	..	5 14 3
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	..	5½%	5½%	5½%	95 — 98	95 — 98	..	..	..	5 12 3
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	8 %	8 %	152 —157	147 —152	155	148½	—5	5 5 3
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	5 %	6 %	123 —127	117 —122	119	..	—5½	4 18 2
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	109 —112	109 —112	111	..	..	4 9 3
233,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,300	100	4½%	4½%	4½%	4½%	102 —105	102 —105	104½	..	..	4 5 9
122,301	British Electric Traction	10	3 %	Nil	Nil	Nil	3/16 — ⅛	3/16 — ⅛	13/1½	..	..	Nil
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	3 %	1½%	2 — 2½	2 — 2½	47/6	42/6	..	6 0 0
1,473,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	85 — 88	85 — 88	86	85½	..	5 16 8
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	63 — 67	63 — 67	..	..	..	6 14 4
100,000	British Insulated and Helsby Cables	5	8 %	10 %	10 %	10 %	7½ — 7⅝	7½ — 7⅝	7⅞	7⅝	..	6 7 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6¾ — 6⅞	6¾ — 6⅞	..	..	..	4 11 3
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
304,940	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	89 — 94	89 — 94	..	..	— 2	4 15 9
400,000	{British Westinghouse 6 % Pref., 1 to 300,000 and 375,001 to 475,000}	5	Nil	Nil	Nil	Nil	7/16 — 9/16	7/16 — 9/16	..	..	..	Nil
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	38 — 42	38 — 42	..	..	..	9 10 6
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	5/16 — 11/16	5/16 — 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	2½%	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	6 %	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	41 — 46	41 — 46	..	..	..	9 15 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	27 — 31	27 — 31	28½	..	..	14 10 2
197,510	Calcutta Trams, 1 to 197,510	5	8 %	8 %	8 %	4½%	4⅜ — 4⅝	4⅜ — 5	..	..	+ 1/16	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,280..	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	96/0½	96/8	..	5 0 0
950,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	97 —100	97 —100	99¼	99	..	4 10 0
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	15 %	10⅜ — 11⅛	10⅜ — 11⅛	10⅝	10⅜	..	6 7 8
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105 —107	105 —107	..	..	..	4 4 1
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	1/16 — ⅛	1/16 — 1/16	..	..	— 1/16	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	6 %	8 %	12 %	12½%	2 — 2⅛	2 — 2⅛	42/-	41/3	..	5 17 8
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4 %	105 —108	105 —108	..	..	..	3 14 1
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	4 %	3 %	3½%	62 — 64	62 — 64	62½	..	..	5 1 7
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	85 — 87	86	85	+ 1	4 14 2
554,655	Do. do. Def. do.	Stock	4 %	4 %	3 %	2½%	43 — 45	43 — 45	43½	..	..	5 11 1
1,480,000	City and South London Railway	Stock	1½%	2½%	3½%	1½%	81¼ - 82½	81¼ - 82½	82½	81½	..	4 12 4
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	5 %	5 %	5 %	⅛ — 1⅛	⅛ — 1⅛	..	..	..	13 6 8
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	9 — 93	90 — 93	..	..	..	5 7 6

* Unless otherwise stated, all shares are fully paid. † A period of nine months. From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1908.	1907.	1908.	Closing Quotations Aug. 31st.	Closing Quotations Sept. 7th.	Business done week ended Sept. 7th, 1909. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	10 %	1⅛ – 1¼	1⅛ – 1¼	24/6	24/-	..	7 12 5
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	6 %	1⅛ – 1¼	1⅛ – 1¼	..	..	..	4 16 0
271,030	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 –108	100 –108	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅞ – 13⅞	12⅞ – 13⅞	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	4½%	4½%	2½%	1¾%	⅜ – ½	⅜ – ½	..	..	..	20 0 0
17,189	Do. "A" shares, 01—017,189	5	4½%	4½%	2½%	2½ %	1 – 1⅛	1 – 1⅛	..	..	..	8 6 8
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	68 – 73	68 – 73	..	..	..	5 9 7
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	84 – 87	84 – 87	..	..	..	5 12 4
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	1/16 – 1/8	1/16 – 1/8	..	11/-	..	Nil
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	7 %	7 %	7 %	7 %	1⅛ – 1⅛	1⅛ – 1⅛	..	..	..	9 13 1
85,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7⅞ – 8¼	7⅞ – 8¼	..	..	..	6 1 3
900,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	85 – 88	85 – 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	1½ %	Nil	¾ – 1	¾ – 1	..	..	..	6 13 4
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ – 10¾	10½ – 10¾	..	..	..	6 10 8
60,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 –103	102 –103½	..	..	..	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15%	15 %	15%	15 %	12½ – 13½	12½ – 13½	13	12⅝	..	5 12 2
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ – 5⅜	5⅛ – 5⅜	5⅛	..	..	4 1 10
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105½ –107½	106 –108	..	..	+ 1	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	10 %	10 %	10 %	14⅞ – 15⅛	14⅞ – 15⅛	13 11/16	..	..	6 13 4
97,500	†Liverpool Overhead Railway, Ord.	10	Nil	Nil	1½%	Nil	⅞ – 1	⅞ – 1	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4½ – 4⅝	4½ – 5	..	..	..	10 10 6
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	3 %	Nil	1⅛ – 2⅛	1⅛ – 2⅛	..	..	..	Nil
599,980	Do. do. 50,008 to 100,000	10	3 %	3 %	3 %	Nil	1⅛ – 2⅛	1⅛ – 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	3⅜%	2⅛ – 2⅝	2⅛ – 2⅝	..	..	..	18 12 8
1,931,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	..	4 %	67 – 70	67 – 70	..	..	..	5 14 4
5,782,069	Metropolitan Consolidated	100	2½%	1 %	1½%	1½%	38⅜ – 39⅛	38 – 38⅛	39	38⅛	– ⅜	1 6 0
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	65 – 67	65 – 67	66⅜	65⅜	..	4 2 1
2,385,000	Do. District	100	Nil	Nil	Nil	Nil	16⅜ – 17⅛	16 – 16⅛	16⅛	16	– ⅜	Nil
291,337	Metropolitan Electric Trams., Ord.	1	..	..	..	44%	⅛ – ⅜	⅛ – ⅜	1/0-	..	..	..
314,016	Do. do. Detd.	1	Nil	Nil	Nil	Nil	⅛ – ⅜	⅛ – ⅜	9d.	..	..	Nil
600,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ – ⅜	⅛ – ⅜	16/-	14/6	..	6 3 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	95 – 97	94 – 96	..	..	–1	4 13 9
10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	127 –130	128 –131	130	128⅜	+ 1	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	..	5 %	96 – 98	93½ – 95½	94⅜	94½	–2	5 4 9
245,500	Potteries Electric Traction	1	4 %	4 %	4 %	Nil	⅛ – ⅜	⅛ – ⅜	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ – ⅜	⅛ – ⅜	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	86 – 89	86 – 89	..	..	..	5 1 2
27,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	15 %	34½ – 36	34½ – 36	35½	..	..	2 10 9
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 –102	100 –102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	..	5 %	102½ –103½	102½ –103½	103⅛	..	..	4 16 7
2,800,000	Do. do. 4½% Bonds	..	..	..	..	4½%	87 – 89	89 – 91	89⅜	88½	+2	4 18 11
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	37 – 39	37 – 39	..	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	Nil	Nil	10 %	Nil	⅜ – ½	⅜ – ½	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 126,001 to 141,666	1	Nil	..	6 %	6 %	2⅜ – 3⅛	2⅜ – 3¼	60/-	..	..	1 18 5
245,495	Do. % 1st Mort. Deb. Stock	..	4 %	4 %	4 %	4 %	76 – 80	78 – 82	..	..	+2	4 17 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	..	5½%	5½%	5½%	5½%	4⅛ – 4⅜	4⅛ – 4⅜	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	93 – 96	93 – 96	..	..	..	4 18 9
80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10%	10	10 %	7⅜ – 8	7⅜ – 7⅝	..	..	– ⅛	6 7 0
2,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅜ – 8	7⅜ – 8	..	..	..	4 7 6
336,376	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	97 –100	97 –100	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 – 4⅛	4 – 4⅛	82/6	..	..	5 11 1
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ – 4⅝	4⅜ – 4⅝	..	..	..	4 12 4
90,000	Do. "City Undertaking" 4½ % Cum. Pri.	5	4½%	4½%	4½%	4½%	3¾ – 4⅛	3¾ – 4⅛	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 – 99	96 – 99	98½	97½	..	3 19 8
49,486	Chelsea Electricity Supply, Ord.	5	8 %	8 %	4½%	4½%	3⅝ – 4⅛	3⅝ – 4⅛	..	..	..	5 9 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 6
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	10⅜ – 10⅞	10⅜ – 10⅞	10¹¹/16	10⅜	..	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ – 12⅜	11⅜ – 12⅜	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 –124	121 –124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 6
50,000	County of Durham Electrical Power, Ord.	5	4 %	4 %	2 %	..	2⅜ – 2½	2⅜ – 2½	..	..	..	3 6 8
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2 – 2½	2 – 2½	..	..	..	7 2 10
260,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	..	5 %	93½ – 95½	93½ – 95½	..	..	..	5 4 9
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	6 %	7⅜ – 8⅛	7⅜ – 8⅛	8	..	..	6 1 3
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ – 11	10⅜ – 11	10⅞	10½/8	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	104 –107	104 –107	..	..	..	4 4 1
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 6
80,000	Edmundson's Electric Corporation, Ord. Shares	5	4 %	Nil	Nil	Nil	⅛ – ¼	⅛ – ¼	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	3 %	Nil	Nil	⅛ – ¼	⅛ – ¼	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	58 – 61	58 – 61	..	..	..	7 7 7
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	..	5 %	86 – 88	84 – 86	84⅛	84	–2	5 16 3
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ – 5⅛	4½ – 5	..	..	– ⅛	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 – 5⅛	5 – 5⅛	..	..	..	4 10 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 –100	97 –100	..	..	..	4 10 0
16,000	Hove, 1 to 16,000	5	9 %	9 %	8½%	8½%	7⅜ – 7⅝	7⅜ – 7⅝	7⅝	7½	..	5 11 6
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	..	..	..	..	5 %	98 –101	98 –101	99½	98½	..	4 19 0
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	10 %	8 %	6⅜ – 6⅝	6⅜ – 7	6¹¹/16	6⅜	+ ⅛	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 – 98	95 – 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	4 %	2½%	3 %	1⅛ – 2⅛	1⅛ – 2⅛	..	..	..	4 16 0
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	6 %	5 – 5⅛	5 – 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4½%	4 %	93 – 97	93 – 97	..	..	..	4 2 6
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	8 %	6½%	5 %	4⅛ – 4⅜	4⅛ – 4⅜	..	..	..	5 7 6
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ – 5	4⅜ – 5	..	..	..	4 10 0
285,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 –108	105 –108	..	..	..	4 3 4
248,000	Do. 5½ % Mort. Deben. Stock Redem.	Stock	5½%	5½%	5½%	5½%	83½ – 86½	84½ – 86½	..	..	..	4 0 11
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	..	5 %	5 %	5 %	5 %	83 – 85	83 – 85	83½	..	..	5 17 8
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	..	3½%	69 – 73	71 – 75	74	72½	..	4 15 11
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	..	7 %	106 –110	106 –110	..	..	..	6 7 3
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	..	..	..	..	5 %	86 – 88	85½ – 87½	86⅞	86½	– ½	5 14 11
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 – 97	95 – 98	..	..	+1	4 11 10
180,491	Newcastle-on-Tyne, 1 to 187,500	5	8 %	8 %	8 %	2½%	4⅛ – 4⅜	4⅛ – 4⅜	..	..	..	2 14 0
187,500	Do. 5 % Pref., 1 to 187,500	5	5 %	5 %	5 %	5 %	4⅛ – 5	4⅛ – 5	..	..	..	5 0 0
126,500	{North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265}	100	..	..	..	..	99 –101	99 – 101	..	..	..	..
18,853	Notting Hill Electric Lighting	10	7½%	7½%	7½%	7 %	11⅛ – 12⅛	11⅜ – 12⅜	12	..	+ ⅛	5 9 10
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 – 6⅛	6 – 6⅛	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 – 98	95 – 98	..	..	..	4 1 8
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	..	2½%	6 %	8 %	1⅞ – 1⅞	1⅞ – 1⅞	..	..	..	5 7 3
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅜ – 1⅝	1⅜ – 1⅝	..	..	..	5 10 4
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 –105	103 –106	103½	..	+1	4 14 4
40,000	St. James' and Pall Mall Electric Light, Ord.	5	12½%	10 %	10 %	10 %	8½ – 9	8½ – 9	..	..	..	7 2 10
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	7 – 7⅛	7 – 7⅛	..	..	..	4 11 10
153,000	Do. do. 5½ % Deb. Stock Red.	100	5 %	5½%	5½%	5½%	84 – 88	84 – 88	..	..	..	5 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	Nil	Nil	Nil	⅜ – ½	⅜ – ½	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	3 %	4 %	5 %	2⅝ – 3	2⅝ – 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	2½%	⅝ – ¾	⅝ – ¾	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ – 1⅜	1⅛ – 1⅜	..	..	..	5 16 8
224,530	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 –105	102 –105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	¾ – 1	¾ – 1	..	..	..	25 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅝ – 2	1⅝ – 2	..	..	..	12 10 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	77 – 81	77 – 81	80	78½	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 800,000	1	..	..	..	5 %	⅞ – ⅞	⅞ – ⅞	18/8	17/8	– ⅛	5 9 7
110,000	Westminster Electric Supply, Ord.	5	12 %	12 %	10 %	10 %	8½ – 9	8½ – 9	..	..	– ½	5 11 1
81,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	5 %	4½%	4½%	4½%	5 – 5⅛	5 – 5⅛	..	..	..	4 3 0

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. Interim Dividend.

NOTES ON LIFE IN WESTERN AUSTRALIA.

By H. J. RITCHIE.

Perth, as the chief city of Western Australia, should naturally receive first consideration in these notes. From a visitor's point of view the immediate environments of Perth are delightful. Anybody who is fond of scenes with broad reaches of river views and stretches of surrounding wooded country, would be in his element during a river trip from the Port to the city, and should he be fond of sailing, he will find great possibilities of enjoyment, especially should he be nearing the city on a Saturday afternoon or Sunday during the summer months, for he will then see the wide expanses of water dotted in all directions with little white sails. It is an ideal river for small craft, and great battles are fought out in miniature on this lovely river, "the Swan."

The living expenses in Perth are not excessive; in fact, a bachelor of moderate tastes can live very comfortably in Perth on £200 a year. Board and lodging can be had for from 25s. to 30s. a week; the boarding house keepers much prefer men to women boarders. In order to give the electrical engineer some idea of comparisons in wages, it may be stated that the ordinary wireman's wages are £3 per week; of course, he provides his own kit. There is little or no demand for armature winders only, but the wage set by arbitration for this work is £3 15s. per week of 48 hours—8¾ hours per day, with the usual half-day on Saturday after 1 o'clock. Most shopkeepers of the city give their employés the Wednesday half-holiday and keep open on Saturday afternoons and evenings, everybody devoting Sunday to a quiet day of enjoyment or rest, according to their individual tastes. The open-air life of the Colony, with its bright, sunny days and beautiful cool evenings, tempts most people out of doors in the summer. The hills are within 20 to 30 miles from the city, and a short ride in the train will carry one to some of the most beautiful wooded country imaginable, with its hills and dales and clear little streamlets running in all directions. Quite a number of city business people have taken up holdings in the hills of upwards of 200 acres, and they spend their week-ends in these delightful spots, employing labour to clear and fence their immediate surroundings, planting acres of strawberries, potatoes, and all kinds of vegetables, the land being watered by springs, and even requiring draining in places. For the hunter there are plenty of kangaroos and wallabies in these hills. Ducks abound in large numbers on the Upper Swan, and on the neighbouring lakes and marshes, but these are preserved from being shot within certain limits. The river abounds in fish of all descriptions, as is evidenced by the numbers of pelicans and other fish-eating birds, which dot the shoals here and there. The islands lying off the coast, which shelter Fremantle, are ideal fishing grounds for the followers of Izaak Walton, and a short run in either a sailing boat or one of the river excursion steamers which call at these islands, will bring one in close touch with these camping grounds.

Perth at the present time is hardly a good hunting ground for those looking for employment in the electrical line, as the building of the city, which has been going on very rapidly for the last 10 or 12 years, has reached the requirements of the Goldfields, to which it owes its phenomenal growth of late years, and until the agricultural industry begins to return some of the immense amount of capital put into it recently, the building trades cannot experience much activity.

From an engineer's point of view the Goldfields are the next (if not the first) places of interest, for it is on these to a large extent that the great wealth of the colony depends. The Kalgoorlie Goldfields, centring in the Golden Mile, are of paramount interest. It is into here that a tremendous amount of machinery has been pouring from all parts of the world for some considerable time past. The writer was one of the first men to put electrical machinery up on the mines themselves (both Coolgardie and Kalgoorlie had municipal plants before that time, namely, 1896). The living on the fields is somewhat dearer than in Perth. Drinks form a large item in one's expenditure, and at one time it was almost useless to attempt to interest a business man in anything you had to put before him without first inviting him to moisten proceedings with you. But that is not so general a feature nowadays, though, the temperature being so much higher and the atmosphere so much drier, it is almost essential to drink something.

The water scheme, which supplies the Goldfields as far as Kanowna with a splendid supply of water, was carried out by the Government at a cost of £3,000,000. This is a magnificent piece of engineering, and is very interesting from an engineer's point of view, especially as the water has added some grave complications, inasmuch as the minerals in solution are eating away the main supply pipes a good deal faster than was at first thought possible.

The mines employ a great number of electric motors for driving outlying parts of their machinery, and the looking after and repairing of these motors requires on some of the larger mines an electrician with two or three assistants. These take their shifts of eight hours each—the mines and their entire plants running continuously. The electrician, if single, usually lives on the mine in the quarters set apart for the mine officials, but the dust which is blown from the numerous dumps makes life close to the mines anything but pleasant. The pay of a mine electrician is usually between £5 to £7, and that of the assistants from £3 to £4 per week. The temperature, which sometimes runs up to 110° in the summer months, is not so noticeable in that extremely dry atmosphere; but the *dust*, when the wind comes up, is everywhere, and is the most trying part of one's sojourn on the Kalgoorlie Goldfields.

For the ordinary visitor there is every comfort provided in the luxurious hotel accommodation, including iced drinks and cool and refreshing lounges, which are most welcome after the excessive heat of the outside atmosphere. The winter months on the fields are delightful, the days being pleasant, and the nights nice and cool—indeed, quite chilly. The rain generally falls during the storms that occur from time to time in the winter, and the place would be admirable to live in, if there were any neighbouring spots of interest from a scenic or amusement point of view to go to; but the surrounding country is very uneventful and comparatively level, with an occasional hill rising a few hundred feet. Kalgoorlie is at a fair altitude above the sea (1 200 ft.), and, the air being so dry, the hospital at Coolgardie has been almost completely turned into a sanatorium.

In regard to opportunities for electrical engineers and others in the electrical profession in Western Australia, there should be great advances made in the future through the use of cheap fuel, especially in the timber districts, where so much fuel in the shape of sawdust is going to waste every year. Some of England's principal makers of gas producer plants are already on the look-out for any opportunity of this kind. The coal mines of the State at Collie are using electric coal-cutters and various other electrical devices. There are several schemes of electrification on the Goldfields which require capital to work them and the right kind of man to take them up. Even the Stalactite Caves, which are a show portion of the State, are lit by electricity.

New countries are more inclined to take up modern ideas than older countries, as they are not surfeited with that bugbear of civilisation, "vested interests."

LIFE IN INDIA.

In our issue of July 16th we reprinted from an engineering contemporary a letter, from a correspondent using the *nom de plume* "Entropy," on "Salaries and Prospects for Engineers in India."

We have now received from India a letter from another writer, in which he says that, from his personal experience, he can confirm every word in "Entropy's" letter. The conditions of living, &c., on his side of India are, at any rate as regards cost, very much under-estimated. Our correspondent writes more particularly to warn young men who contemplate going out to India against the unreliability of Indian houses—not always electrical, but various trade and commercial houses—on the point of agreements. He alludes to

the malpractices and injustices which professional and other men often have to put up with at the hands of unscrupulous firms. He enters into certain details regarding an experience of his own, which has ended in legal proceedings being set on foot by him against a firm of agents out there. He does not appear to be impressed at all favourably with the standard of business *morale*, and on that ground he desires us to impress upon young men the importance of having the conditions and terms of their employment most clearly defined in their agreements. The writer alludes to the question of the status of the engineer, and says that, if the Institution of Electrical Engineers takes up this matter seriously, it should formulate such regulations as will guard the truly qualified engineer from "such treatment as is generally associated with the ordinary mechanic and labourer on hourly wages." He proceeds to offer the following interesting notes on the conditions and cost of living in Bombay :—

"Engineers in this country have a higher social status than that which they are accustomed to at home, and they are expected to live up to it; by reason of this fact alone their salaries should be commensurate with the position they are called upon to fill in Society. It is necessary, therefore, if they are to fill their positions to do full justice to the prestige of the profession and credit to themselves, that a salary of not less than Rs. 600 (£40) per month should be asked by any engineer over 24 years of age possessing even the most ordinary qualifications, and an unmarried man.

This figure is based on the consideration that it is not worth while for any man to come out to a country such as this unless he is able to save out of his earnings at least three times what he would at home, and even that is little or no compensation for the ills which he must necessarily bear on account of the climate, and so forth.

I lived for a period of 16 months in a hotel, and I have taken the average for that time. It must, however, be borne in mind that I obtained a concession for a long term of residence, and occupied a room which was graded at the lowest price, excepting those on the ground floor, which were Rs. 30 per month cheaper. Living on the ground floor in Bombay is considered unhealthy, and for that reason alone the cost should not be based on this figure.

Hotel (board and lodging, including minerals)	Rs. 225
Clothing averages about	45
Dhobie (washing)	6
Boy (servant)	20
Clubs and incidentals	150
	Rs. 446

or, say, £29 14s. 8d. per month.

If with a number of three other fellows a "chummery" is formed and a flat taken, its cost, including lights, lifts, servants, would work out to a matter of about Rs. 50 to Rs. 60 per month cheaper than hotel life. In any respectable locality in the Fort a flat cannot be obtained under Rs. 250 per month, and then it would be difficult to get four bedrooms with it. A married man should demand a salary proportionately higher, but my advice is that India is no place for women and children, and the man who brings his wife to the country must be prepared for additional expenses in the way of providing changes to the hills, and so forth. The flats are rented exclusive of furniture."

RAPID FLOW OF GASES THROUGH BOILERS.

With reference to the findings and conclusions of the U.S. Geological Survey Department on the subject of draught through boilers, the following statements may be noted :—"With gases there is no pulling, only pushing. Gases travel from places of higher pressure to places of lower pressure, the motion of the gas taking place because of its expansion." Such a statement ought to be axiomatic. A fan induces a draught by creating a locus of low pressure by centrifugal action. The action of a chimney is precisely the same in effect, though the mode of producing the effect is very different. The Department's experiments were made with layers of lead shot to represent the fuel bed on a grate surface. Presumably this lead shot device would act very much as does a layer of fuel; but a layer of burning fuel is a constantly varying quantity of constantly changing resistance, and it would be difficult to deduce a law from any observed resistances under such variable conditions. As observed then, with layers of shot, the rate of flow of air through a bed of shot is approximately proportional to the square root of the pressure drop through the layer.

An increase of the thickness of the shot bed causes at first a rapid decrease in the amount of air passing through. Further increase only produces slow diminution. This result is what might be expected, for the reduced volume of air will find little resistance from the top layers of shot.

To drive air at the same rate through a double thickness of shot requires twice the pressure difference and double work.

The work of a fan will probably be doubled, if any of the three following quantities be doubled, viz. :—

The number of rows of tubes in a cross-flow water-tube boiler.

The length of tubes in a parallel-flow boiler.

The thickness of the fuel bed.

The above supposes an equal weight of gases to be put through in each case.

If in a multi-tubular boiler the tubes be lengthened and their diameter be kept the same, the heat absorbed will be slightly increased if the pressure difference between the tube ends is the same, though there will be less air passing through.

High rates of combustion do not follow on a large pressure drop through the fuel bed; the reverse is more likely to be true. High-pressure drop always means a high resistance. This is a point that would naturally be anticipated; a high resistance, for example, would attend on a fire that was much choked with small coal.

This pressure drop only has special significance when considered in connection with the total pressure drop.

The capacity of a boiler or its ability to produce steam increases with the difference of pressure between the uptake and over the fire. Where the total pressure drop is constant, the boiler capacity, as a consequence of the foregoing, decreases as the pressure drop through the fuel increases.

The general conclusion may be drawn from the foregoing observations that every reasonable endeavour should be made to preserve a fire so open as not to offer serious resistance in the fuel bed. Now, this end is likely to be attained where all the fuel particles are of the same size. In a run-of-mine coal the large lumps act as an effectual barrier to the passage of air so far as regards the projected area of the lumps; but if all the lumps are large, there will be considerable air space between lump and lump. But when all round each lump there is a mass of smaller coal of all sizes, the air spaces will be choked. Some air will get through any agglomeration of small coal, but no air can get through a lump of coal of any size. Hence the difficulty in burning run-of-mine, and the advantage in burning sorted coal of even sizes. For with every coal the larger pieces afford a solid resistance to the passage of air, and the passage round about the larger pieces is blocked where smaller coal is present.

Generally a small coal will not burn at the rate of large coal. It is true that in a fire, say 9 in. in depth, the fuel may be alight all the way through the mass if the coal is small, whereas with lumps of approximately 9 in. cube there can only be two horizontal surfaces alight; but the sides of such large pieces are exposed to a very rapid draught action through the open air spaces.

Practice, however, would not employ such large pieces unbroken unless in the fire-box of a locomotive, where the fire-bed is very deep. Experience teaches a fireman to break large lumps into pieces the size of the fist, and this is the outcome of what is pointed out above, that large pieces when surrounded with smaller coal are absolute barriers to air flow. The relative advantages of graded coal as compared with ordinary mixed fuel could doubtless be shown fairly well by the methods adopted by the U.S. Geological Survey Department, employing shot of mixed sizes, so as to illustrate the amount of resistance that would be introduced by large coal enveloped in slack.

It is fortunate that, in burning, coal breaks up and speedily affords passage-way for air, and because of this, the full effect of big lumps is not experienced. They break up and open up fissures before they get down to the grate surface, and they are thus prevented from causing their full detrimental effect. On the other hand, any coal with a fusible ash may completely cover a grate surface with a sheet of clinker that will stop all combustion of the solid carbon on the grate; hence the demand for bars which can be rocked so as to break up the clinker, or even cut it out from the base of the fuel bed and drop it into the ash-pit. The difficulty is that, unless such clinker is bared of fuel, it will not break up, but will simply bend above the rocking bar fingers. In the choice of fuel, therefore, very much may hang upon other qualities than high calorific power. A coal that does well with a gentle draught, and a moderate grate temperature, may quite fail if the work is pushed and the fusion point of the clinker is exceeded. And so with the use of lime to absorb sulphur from the coal; even if the lime will do this, it may also help to liquefy the clinker and produce a choking effect that would not otherwise be produced.

One of the things that are required is a larger grate area in ordinary boilers, in order that full advantage may be taken of gentle draught. Heavy draught has more limitations than the large power it demands. It may mean, as above, a liquefied clinker, and coals otherwise good may be ruled out of a coal contract. Ruling out any one coal invariably means that those not ruled out will be more highly priced. And should the high velocity idea possess even a sound basis in theory, there is much in practice that will render its application of very doubtful value, for what we burn on a fire-grate is not all combustible matter, nor is it infusible, and the limit to extreme draught is set by temperature at the grate surface. It will not be denied that a large grate surface might have small gas passages through the boiler so as to secure the high velocity everywhere except through the grate; but there is an early limit to this as the Bulletin shows, for much power is required to push air through very narrow passages. Those who advocate such high velocities have not, perhaps, waited to calculate fully the power effects. B.

THE PECKHAM PATENT PENDULUM GEARED TRUCK.

Mr. Sayers has reported well of the newest "cure-all" truck, and he has been rewarded by seeing his name mis-spelled on almost every page of the catalogue just issued by the Peckham Truck Co.

To those who have little faith in the radial truck, in one of its many guises, or to those who have faith, but insufficient means to buy them, it would appear from Mr. Sayers's report upon the truck which he tested at West Ham, that the pendulum gear offers all the advantages of the radial truck at a smaller cost.

"The special feature of the truck is that the weight is taken on the axle boxes through pendulum links or shackles which permit of independent lateral movement of the wheels and axles, a movement which is sufficient, when applied to so short a wheel base, to follow track curvature and irregularity without excessive flange pressure. Attending such lateral displacement there is always a restoring force due to the inclination of the links, which tends to bring the body and the wheels back to the normal relative position corresponding to straight track as soon as the curve is left. The motor suspension is so arranged that the motor moves freely with the axle, and therefore obviates those side pulls on motors, &c., which produce excessive wear of bearings, collars and gears.

"The cross bars carrying the motor suspensions are also utilised as cross braces or stiffeners between the main side frames, and are braced together by diagonal struts forming with the main frames a stiff structure of great strength, calculated to keep 'in square' against all stresses likely to be brought against it. It is obvious that the lateral freedom of the axles and motors reduces these stresses, so that the truck is at once less severely tried and more adequately strengthened against them than are four-wheeled trucks of the usual types."

One of these trucks has been in constant use on the West Ham Tramways for 14 months, and has required less attention than the other trucks. This fact helps us to believe that the pendulum support prevents shock and side blows to motors, gear trucks and body.

Mr. Sayers further considers that rail corrugation would be reduced or eliminated by the use of the pendulum gear, and that power consumption and cost of maintenance will be lowered.

THE PRESERVATION OF POLES.*

There are about 40,000,000 poles in use in the United States, by telegraph, telephone and other companies, valued at $5 to $7 each on an average, or a total of $200,000,000 to $280,000,000. It requires about 3,800,000 poles each year to replace those that have become useless from decay. The average life of white cedar and chestnut poles in the United States, other than the Gulf States, is about 12 years. Hence, the depreciation is about 8½ per cent. per year, or $17,000,000.

It is now a well-established fact that the cause of the decay of poles at the ground line is a fungous growth. Furthermore, it is known that this growth attacks the pole from the outside and not the inside, except, of course, in cases of butt rot.

It is a popular notion that deep penetration of germicides is necessary effectively to preserve timber or poles. This is not true. The wood-destroying germs begin their ravages on the outside and work toward the centre of the pole. It follows, then, that if the germs on and near the surface of the pole at the ground line can be destroyed, and the myriads of germs in the air and in the soil surrounding the pole can be excluded, the pole will be preserved. The only advantage there is in deep penetration when using the old methods is that it requires a longer time for the germicides to be leached or washed out.

As most germicides which are cheap enough and powerful enough to be used in preserving poles are soluble, any mechanical device adopted must serve the following purposes: It must exclude the germ after the pole is treated and at the same time retain and protect the chemicals in constant contact with the pole at the ground line; it must also prevent the chemicals from being taken up and absorbed by the surrounding soil.

The method adopted by the Universal Post and Pole Preserving Co., of Circleville, Ohio, is first to dig down around the pole a distance of about 14 in. from the ground line, and clean off any decayed wood from the surface of the pole. A layer of Portland cement mixed with sand is then placed around the pole at the bottom of the excavation. Next, a "hydrobestos" jacket is placed around the pole, and 1 to 2 in. therefrom, imbedding the lower edge of it in the cement. The two edges of the jacket are lapped from 1 to 2 in., and fastened with a specially prepared cement and tacked upon a lath inside the jacket. The space between the pole and the jacket is filled with germicides in a dry state, mixed with sand. Around the top of the jacket is formed a reinforced cap or collar of Portland cement, embedded in which are one or more wires around the pole. The collar protects the chemicals and jacket from the action of the rain and snow, and, if along steam railroads, protects the pole against the numerous grass fires. The chemicals are slowly dissolved by the natural moisture in the pole, and pass into it by capillary attraction. As they cannot pass out into the surrounding ground they go into the pole, thus destroying all fungi and wood-destroying insects. Thus there is a continuous absorption of chemicals and a mechanical exclusion of germs.

The hydrobestos jacket used around the pole is a pure mineral, composed of specially prepared and purified asbestos and asphaltum. This material is subjected to a pressure of about 27,000 lb. per square inch in its manufacture, and is a very important factor in the method. There is no animal or vegetable fibre in it, and it is practically indestructible in the situation used. In some special locations the jacket may be made of cement.

The reinforced Portland cement cap is an important part of the protective device. It prevents the rain and snow from entering the receptacle, holds the germicides, and gives a stability and attractiveness to the pole.

The germicide used consists of hydrated lime and chloride of sodium, mixed with coarse sand and one-fourth to one pound of sulphate of copper (per pole), according to size and condition of the pole. These proportions may be varied somewhat in the case of partially decayed poles, according to condition.

On small jobs the men work in gangs of three. One goes ahead and digs around and cleans the poles, and the other two follow with a one-horse wagon or hand truck containing the chemicals (if the line of poles is along the road or on the streets of a city), and finish the treatment. Or the material may be distributed in small sacks to each pole from a hand car, if along a railroad.

One gang of men can treat from 20 to 30 25-ft. poles per day. A much larger number of new poles can be treated in a day. The cost depends upon the accessibility of the poles and whether the materials are purchased in carload lots or not, and also the price of labour; but it may be said that the cost would be from 75 cents to a dollar per pole, including royalty for the patent on the process. Some very large poles worth from $50 to $75 have been treated at a cost of $1.50 up to as high as $2.50. Even this will pay, when the cost of removal and renewal of the pole is taken into consideration. These figures may be reduced on large contracts.

According to the Government experts, the open-tank treatment costs 67 cents per pole, not including hauling.

Poles which were partially decayed when treated, after over nine years show no increase in the decay, and the protecting device is in good condition.

* Abstract (from the New York *Electrical Review*) of a paper by H. P. Folsom, presented before the 18th annual convention of the Association of Railway Telegraph Superintendents, at Detroit, June 23rd, 24th and 25th.

EXHIBITION OF MACHINERY FOR WIRE-DRAWING, &c.

For the last few weeks an exhibition of wire-drawing machinery has been held at the works of Messrs. Sir James Farmer & Sons, Ltd., of Salford, who are now building the continuous wire-drawing machines covered by the "Geck" patents. Many firms interested in this class of machinery have attended, and most of the important wire manufacturers have inspected the machines in operation. The

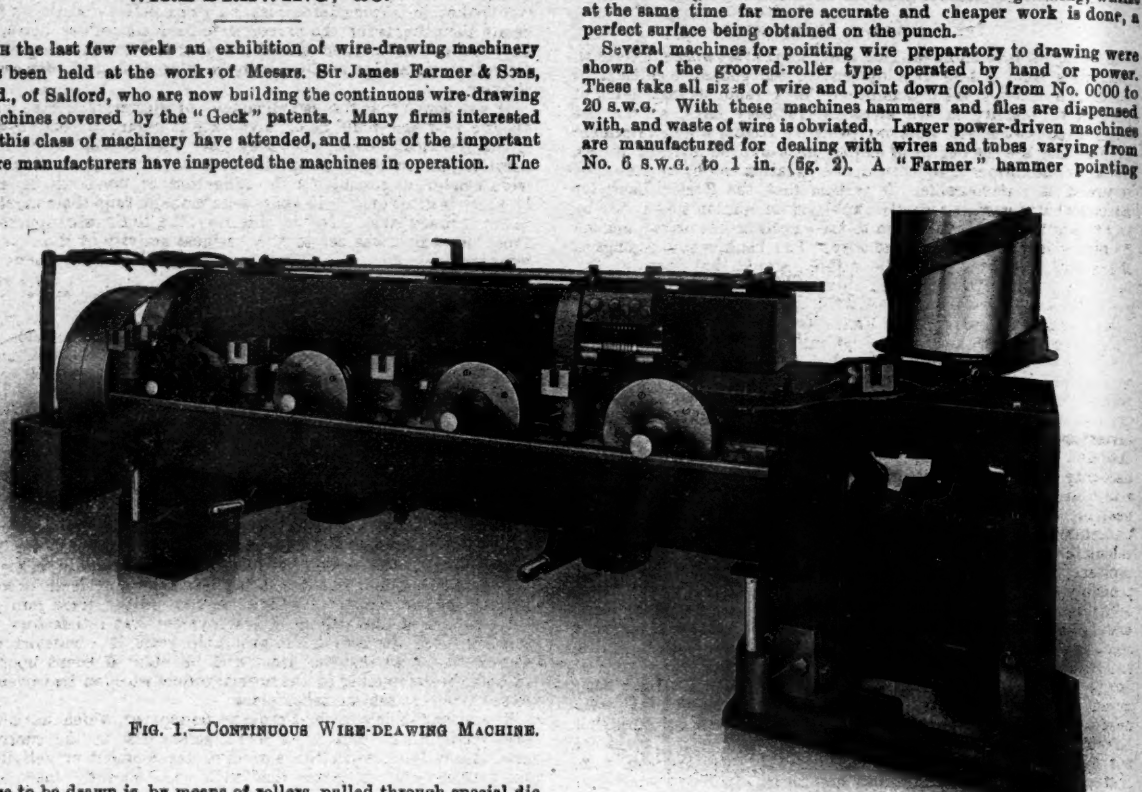


Fig. 1.—Continuous Wire-drawing Machine.

wire to be drawn is, by means of rollers, pulled through special die plates of "Vienna" steel on to the finishing block. These rollers run at different speeds to compensate for the lengthening of the wire in the process of drawing. A trough of lubricant is provided in which the rollers run whilst the machine is at work; this trough is so made that it can be lowered whilst threading up the machine, or when the machine is standing empty. The largest machine, No. 00 (fig. 1), takes mild steel rod of No. 5 or 6 s.w.g., or copper

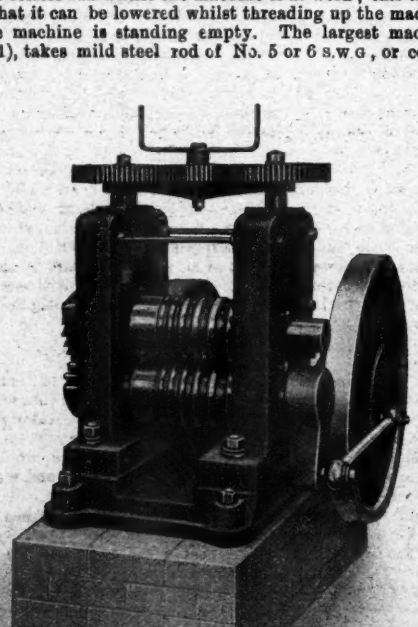


Fig. 2.—Eccentric Pointing Machine.

rod No. 3 s.w.g., and reduces it to No. 14 s.w.g. in one operation through five dies. This machine running at 35 r.p.m., with a finishing block of 16 in. diameter, produces daily about 13½ cwt. of mild steel wire. When dealing with copper and running at 80 r.p.m. it is capable of turning out about 42 cwt. per day. Other machines were on show varying in size and capacity, the smallest turning out wire of 35 s.w.g. These continuous wire-drawing machines are in operation in some of the most important of the English wire mills.

An automatic punch-grinding machine was also in operation grinding the ordinary round punches used in wire mills. This machine is a great advance on the hand method of grinding, whilst at the same time far more accurate and cheaper work is done, a perfect surface being obtained on the punch.

Several machines for pointing wire preparatory to drawing were shown of the grooved-roller type operated by hand or power. These take all sizes of wire and point down (cold) from No. 0000 to 20 s.w.g. With these machines hammers and files are dispensed with, and waste of wire is obviated. Larger power-driven machines are manufactured for dealing with wires and tubes varying from No. 6 s.w.g. to 1 in. (fig. 2). A "Farmer" hammer pointing machine was shown taking copper rods up to ⅝ in. diameter, and steel up to ⅜ in. diameter.

A machine for automatically polishing diamond dies was also shown. This machine, which was of high-class workmanship, was very interesting. The die to be polished is placed in a chuck, and a needle provided with diamond powder automatically moves in and out of the die whilst it is turning round at a high speed, and polishes the die to the required size. This machine is also used by makers of metallic-filament lamps, for cleaning and polishing diamond dies through which the filament is passed.

Mr. Ed. Brand, of 472, Moss Lane East, Manchester, is the sole selling agent for this country, and all communications relative to these machines should be addressed to him personally.

THE GERMAN ELECTRICAL INDUSTRY.

Outbreak of a War of Prices.

The depression in trade during 1907 and 1908, which can by no means be regarded as having been overcome, has, in general, less prejudicially affected German economic life than the preceding critical period at the beginning of the present century, and this observation applies particularly to the electrical industry in that country. In discussing the subject in the course of two lengthy articles, the *Frankfurter Zeitung* first compares the present situation with that which obtained in 1901. At that time the collapse of large electrical undertakings took place, and dividends rapidly declined in the case of others; and in the result there was a brushing away of financial methods which had proved to be mistaken. On the other hand, things are quite different at the present time, as no difficulties have arisen in connection with any of the large electrical groups. Strengthened outwardly as hitherto, the large electrical undertakings stand forth, and it is not at all probable that the results, in so far as they flow to the shareholders in the form of dividends, will experience large diminutions for the past year. Of course, the electrical companies have not on this occasion remained untouched by the change in the times. It can be assumed with some definiteness that, in so far as the dividends hitherto paid are maintained, it will be necessary in many cases to draw upon the "still reserves" to a considerable extent. Owing to the inadequate method in which the German electrical companies mostly announce their profit and loss accounts to the public, it is not only possible, but also probable, that the measure in which old and accumulated profits will now be brought into account will be

withheld from general knowledge, so that the influence of the unfavourable course of time will be calculable either only with difficulty or not at all.

The Degree of Employment.

Although a favourable reaction is expected everywhere in German industries from a new development of the general condition of trade, it seems that the presumptions for a rapid strengthening of productive activity in the electrical industry have, so far, not manifested themselves. The two principal factors which determine profitability are the degree of employment and the level of prices. As far as the former is concerned, the situation can by no means be regarded as unfavourable. It is true that the Zurich Bank for Electrical Enterprises recently expressed an opinion that is not by any means favourable in regard to the extent of the orders and the problems in the electrical industry. The bank, which belongs to the group associated with the A.E.G., stated that there was an increasing inclination on the part of State and communal authorities to undertake the production of electricity on their own account, and thus considerably limit the scope of electrical firms. But, as compared with this position, the Frankfort newspaper points out that the private electrical firms come into consideration as contractors for such central stations, and states that dissatisfaction would by no means be expressed everywhere in such circles at playing the *rôle* of contractor without individual capital investment. Certainly, possible profits from financing are not obtained in this way; but, on the other hand, the risk and the necessity to expend considerable sums without a speedy large return are not present. In general, the prospect of remunerativeness of, for instance, an electricity works created by a private undertaking, is not very favourable. Private industry cannot calculate upon a profit of from only 4 to 5 per cent. of the invested capital. As against this, communal or provincial interests are probably able to be satisfied with a very low interest on the shares taken up in a municipal or State electricity works, as approximately the same conditions prevail in these cases as in those of secondary railways. If the latter are established by companies, the results in general are frequently very unsatisfactory, at least during the more or less lengthy period of development. But a communal or district authority, owing to the advantages which indirectly devolve upon it by reason of the railway connection, can very well be satisfied with a low rate of from 1½ to 2 per cent. Thus it has not been regarded with disfavour in electrical circles that still more central stations have arisen, and are arising, on a co-operative or joint basis of local authorities. Only a relatively few central stations of the kind are erected by the large electrical companies for their own account, and these only, generally speaking, when specially favourable conditions exist in relation to profitability.

The Conversion of Railways.

It is not to be mistaken that the expectations of the electrical industry, in so far as the problem of the conversion of State railways is concerned, have experienced a great disillusion. The German State railway authorities only approach the transformation of steam working to electric traction in a very reserved way. For instance, the orders are only now about to be placed for the first small section on a northern railway, the hesitating attitude of the authorities being due to various reasons. Above all, the general financial situation prevents the consideration of problems which, taken as a whole, would require the expenditure of millions of pounds. The question of permitting private industry to convert State lines to electric traction finds its greatest obstacle in the apprehensions of the railway authorities that it would be the means of creating dangerous competitors of the steam railways. This situation of the matter is doubtless very unpleasant for the electrical groups, as they have expended considerable sums, not only on experiments, but also in the extension of their organisation, in the hope of receiving orders for transformation of State railways. But, on the other hand, it would be incorrect to assume that the companies could have reckoned on a rapid profitability from new problems of this kind, as good things proceed slowly. If, for instance, a section is organised for electric traction, the work of completion would occupy a period of at least two years. As a matter of necessity, the State railway authorities would watch the working of the converted section for a long time in order to determine the operating expenses and cost of maintenance and compare them with steam locomotion. It would only be possible to ascertain the results after a total lapse of from four to five years from the beginning, and, if favourable, larger orders could then be counted upon, although they would not follow very quickly. But the postponement of the conversion of a main line in Germany has had other unpleasant accompaniments for the electrical industry, which is accustomed to work on a large scale for abroad. The possibility, above all, is lacking to demonstrate a large section in actual working before foreign interests, and in this connection it has to be considered that other countries, especially where cheap and large water powers are available, would, perhaps, be rather disposed to proceed with the transformation of the railways. It has also to be remembered that the German firms have to reckon with strong foreign rivalry in this branch, and that a beginning of conversion work has already been made in the United States, Italy and Switzerland.

It cannot be doubted for the rest that sufficient opportunity is offered to the German electrical industry to give practical proofs in so far as large problems are concerned. Numerous projects, particularly from abroad, have been submitted to German undertakings, from States and cities, but it has to be noted that the industry has recently shown great reserve in regard to such proposals. Shyness is manifested towards the investment of considerable sums in new undertakings without the guarantee of quick returns—and this is one of the best lessons of past times. It thus happens that many of these schemes are declined by the German companies. It has further to be considered that the firms believe that they must retain their funds for the problems to be dealt with at home, and they are also not certain that the capital for the financing of new foreign undertakings would readily be placed at their disposal in Germany.

It was hoped that the establishment of electrical trustee banks about a year ago would be of advantage in regard to employment in the electrical industry, but they have hitherto not found remunerative activity owing to special reasons. In order to provide as wide a public as possible for the obligations or bonds to be issued by these institutions, endeavours were made to fund the obligations as far as practicable. But in this way the limit was apparently exceeded which was set to the business activity of these undertakings in reference to their readiness for the placing of orders. It is perhaps possible that in times of scarcity of money at high rates, the communes, large undertakings, &c., will agree to sanction the conditions now put forward by the electrical banks for the advance of money. But this is not true in periods of an abundance of money at low offers, as in these cases the communes will procure money more easily in another way. As a consequence, the electrical banks, so long as their statutes have the present form, will not be able to reckon upon a more extensive activity except in times of dear money, although it is an open question whether the matter of revising the statutes will not be taken into consideration at a given moment. But in this event, the funding of the bank's obligations, and the obligations themselves, would naturally be judged otherwise than hitherto. If it is relatively easy for the large electrical companies to renounce many new foreign schemes, the reason lies in the circumstance that not unfavourable experience has been gained during the recent deep depression in reference to regular manufacturing employment. It has been shown, at least in so far as quantity and value of the new regular orders come into consideration, that the degree of employment was satisfactory. If this has been the case in unfavourable years, it is believed with some definiteness that the firms will be able to count upon an increase in the number of the normal orders when an improvement in the general situation takes place.

The second article of the Frankfort newspaper, which deals with price competition and price level, refers first to the enormous expenditure incurred in the extensive development of activity in the past decade. It states that until quite recently there were, after the purification brought about by the crisis at the turn of the century, three large groups—the A.E.G., the Siemens-Schuckert Works and the Felten & Guilleaume-Lahmeyer Works—which occupy a commanding position in the industry. In addition to these, there is a large number of independent firms, although these are only of less relative importance for the aggregate business, particularly abroad. Competition between the large firms exists in certain departments, but in others arrangements have been made to obviate it, as, for instance, in the incandescent lamp syndicate, the cable syndicate, and other combinations. The bonds between the large firms were so intimate as to lead to the formation of the so-called secret syndicate, which was referred to at length in the Electrical Review of October 30th, 1908, but which has undergone a considerable restriction under the pressure of public criticism. The joint working of the large firms under the arrangements just mentioned referred to the inland market, and it also extended to foreign business, in connection with which both joint transactions and joint enterprises were undertaken. Not only so, but the joint establishment of an electrical bank by the A.E.G. and the Siemens group affords proof that the antitheses between the large undertakings were more and more mitigated and partly removed.

The Struggle for Orders.

If, notwithstanding these circumstances, brisk competition has also proceeded between the firms in certain branches, this was caused by the diverging interests of the undertakings, which were constantly striving for expansion and increase of power. In addition, the activity of the smaller firms came into consideration as they endeavoured to get into the business, and were compelled to work on the basis of relatively low prices. It is, however, certain that, despite all the competition which has prevailed, a race for orders at any price has taken place recently of an extent that has hitherto seldom been observed, and which is not solely to be explained by the general economic depression. During the course of recent time a new factor has appeared, which seems to impart a fresh direction to the development of the industry, as the peculiar event is manifested that, in a period of far-advanced concentration and organisation of trade in the case of the three strong undertakings, a new enterprise has, not without success, made exertions to place itself among the ranks of large firms in regard to all branches. This is the Bergmann Electricity Works Co., which, from small beginnings and a share capital of £50,000 in 1893, has developed into an undertaking with a share capital of £1,050,000 and an obligation loan of £500,000, and has hitherto yielded the highest dividends among the companies in Germany. The Bergmann Co. was for some time outside the Glow Lamp Syndicate, but finally a friendly arrangement was made with it; and a similar observation applies to the company in regard to the Cable Makers' Syndicate, which, after a brief collapse, was renewed in May, 1909, after prices had receded to 30 per cent. below the prime costs.

The turbine branch also brought considerable differences to light. At the end of 1908, the 13 or 14 companies and firms who construct turbines met in conference with the object of restricting competition by apportioning the production among themselves, but the

negotiations failed to accomplish the object in view. A very severe contest consequently occurred, and there is now a bitter struggle for the orders on the market. The general price fight has necessarily drawn all circles of the electrical industry within its scope, the only manufactures remaining untouched being those controlled by syndicates. Although the large groups which are well equipped will pass through the struggle the best, the situation is unfavourable for the undertakings which have only recently extended their organisation or are only now bringing it to completion. The Frankfort newspaper considers that the largest firms also will finally be weakened by the competitive conditions which now prevail, although it is contended that they should not diminish their power in relation to foreign competition at present. Apart from the American electrical industry, the large German firms are by no means placed on a bed of roses in other foreign countries, especially in England. The British industry has now been largely extended, and, in its endeavour to again secure the home trade, the German firms find that they are compelled to do business on much more unfavourable terms than hitherto; and similar circumstances could be proved in the case of other markets. In conclusion, the newspaper states that the interests of the community will not be served if contests are conducted which would result in the suppression of independent undertakings and pave the way towards the constitution of a trust in the manufacturing industry.

METALLIC-FILAMENT LAMP TRANSFORMERS.

Considerations Regarding their Technology and Economics.

By L. CROUCH.

(*Concluded from page* 366.)

"*No-Load*" *Losses.*—The calculation of the "no-load" current of an auto-transformer is a very important operation in its design, for the magnetising current is practically constant at all loads, and must therefore, for efficiency, be a minimum. Its calculation is simple, and gives results

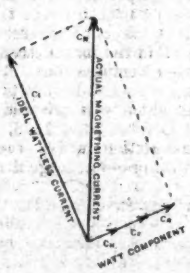


Fig. 8.

agreeing closely with subsequent test data. The most important function introduced is the reluctance of the magnetic circuit, and to determine this, experimental data must be relied upon.

The ideal magnetising current is wattless, since all the energy stored in a magnetic field is, theoretically, restored on the collapse of that field. Denoting this current by C_L, fig. 8, it may be calculated from the equation :—

$$\text{R.M.S. } C_L = \frac{B}{\sqrt{2}} \cdot \frac{1}{\mu} \cdot \frac{10\,L}{4\pi T}$$

$$= \frac{1}{1{\cdot}76} \cdot \frac{B}{\mu T} \text{ amperes,}$$

where B = maximum induction in the iron,

μ = permeability of iron,

L = length of iron circuit,

T = number of turns in transformer winding.

To this current must be vectorially added the current required to supply the watts lost by eddy currents, hysteresis and C^2R in the iron and copper respectively. The eddy and hysteresis losses per pound of iron are experimentally determined at various induction densities (see fig. 9), and if the loss be w watts per pound at the flux density employed, then—

$$(C_H + C_E) = \left(\frac{w \times \text{weight iron in lb.}}{\text{volts}}\right) \text{amperes.}$$

C_H = hysteresis component of the magnetising current fig. 8.

C_E = eddy current ditto ditto ditto.

The current corresponding to the C^2R losses is at once known, and is, say, C_R.

By compounding C_L with $(C_H + C_E + C_R)$ at right angles (as in fig. 8) the true magnetising current can be read off, the accuracy of the method being only limited by the accuracy with which the iron employed is tested and the extent to which the iron is altered in properties by being built up into the core.

These notes will enable the magnetising current of a transformer to be calculated in any particular case, and the importance of this current has been already explained. The magnitude of the no-load current varies very considerably with the capacity of the transformer, being in some cases as

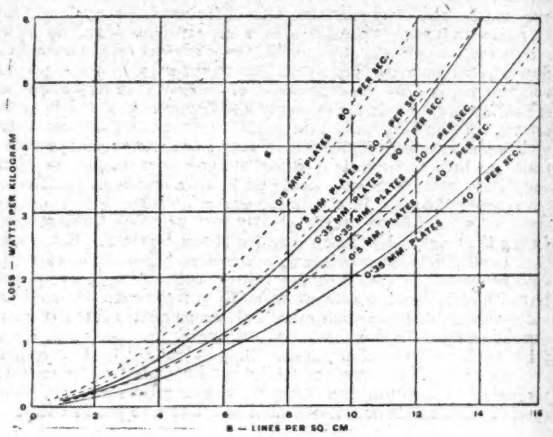

LOSS — WATTS PER KILOGRAM
B — LINES PER SQ. CM
0·5 MM. PLATES 60 ~ PER SEC.
0·35 MM. PLATES 60 ~ PER SEC.
0·5 MM. PLATES 50 ~ PER SEC.
0·35 MM. PLATES 50 ~ PER SEC.
0·5 MM. PLATES 40 ~ PER SEC.
0·35 MM. PLATES 40 ~ PER SEC.

Fig. 9.

high as 1·5 to 2 per cent. of the output in "simple" transformers taking up to 30 amperes, and 0·75 to 1·50 per cent. in cases where the current exceeds 30 amperes; in other instances an 800-watt simple transformer may have light losses as low as 6 watts on a 50-cycle supply and 4 watts on a 100-cycle circuit. For frequencies much below 50 ~ per second, a special winding is necessary on auto-transformers. The extent to which no-load losses can be reduced by the use of good iron has already been stated to be about 40 per cent. of the first-mentioned percentages above.

Cost of Auto-Transformers.—The success of any such apparatus as the present, depending on the ordinary householder for its chief sale, must vary largely with the price at which it can be placed on the retail market. Hence the examination of the prices of auto-transformers and the example given later of its economic value, form possibly the most important section of this article from the point of view of the non-technical reader.

The main laws governing the price of auto-transformers are that *the cost rises*—(1) As the frequency of supply falls; (2) As the primary voltage rises, the ratio of transformation being constant; (3) As the current capacity rises—factors other than those mentioned being assumed to remain constant throughout. The variation of price with the ratio of transformation is dependent on the make considered, being a direct function in some cases and an inverse function in others. The prices of similar transformers by various makers agree very closely, so that the data from which the above deductions are drawn and the curves in figs. 10-12, which illustrate them, are very valuable for general reference. The current capacities referred to in these tables and curves are the maximum currents that can be supplied by "simple" auto-transformers or dealt with as out-of-balance currents by "balanced" transformers. In the later case, the total secondary current that can be supplied may be six or seven times the current tabulated.

On increasing the frequency from 40 ~ to 100 ~ per

second the price of a transformer of any stated output falls by from 15 to 20 per cent. (on the 40 ~ cost). Increasing the primary voltage from 100 to 250 volts raises the price by from 45 to 60 per cent., reckoned on the lower price, while

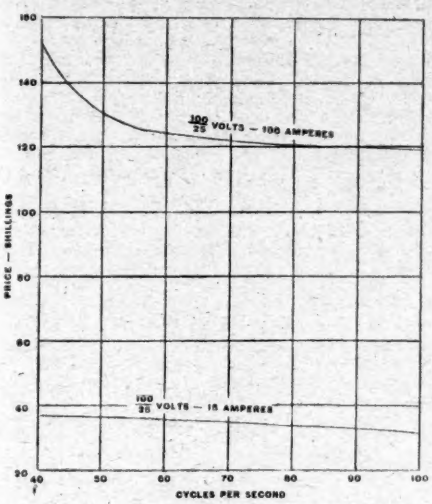


Fig. 10.

increasing the current capacity of a certain type from 5 amperes to 100 amperes (*i.e.*, in the ratio 1 : 20) increases the cost from £1 13s. to £12 8s. (*i.e.*, in the ratio 1 : 7·5). As a guide in estimating, the curves of fig. 13 may be referred

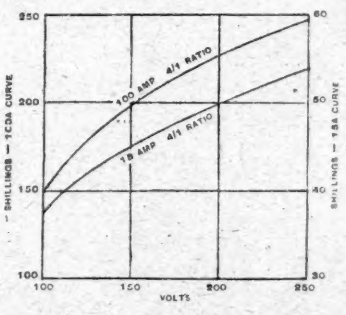


Fig. 11.

to, showing the cost in shillings per kilowatt capacity of transformers for various ratios of transformation. A primary pressure of 200 volts and a frequency of 50 cycles per second are assumed. For other conditions of supply fig. 13 must be used in conjunction with figs. 10-12. The humps

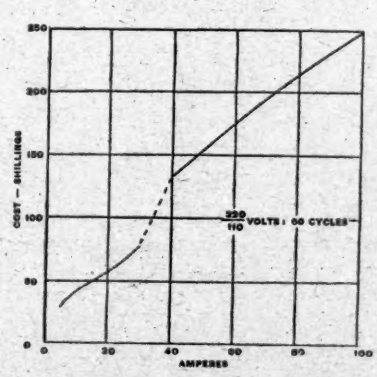


Fig. 12.

in the curves of fig. 13 are due to the necessity of making considerable variations in design if the current capacity is to exceed a certain limit, the latter depending somewhat on the ratio of transformation, as shown by the lateral displacement of the humps. This results in a material rise in the price per kilowatt at the limiting capacity, but the normal course of the curve is rapidly returned to as shown.

Example of the Economies Attending the Use of Metallic-Filament Lamps and Auto-Transformers.—The following example, based on a very ordinary installation and making assumptions which are clearly stated in order that the perfect legitimacy of the conclusions arrived at may be indisputable, will serve to bring home, in concrete form, the practical application and effect of the matter already given.

The capital and running costs of exactly equivalent carbon and tungsten lamps are compared. The capital cost is assumed to merely cover the cost of lamps and of the auto-transformer in the case of metallic-filament lamps. This will save confusion since, with the exception of the transformer, the cost of wiring and fitting is identical in the two cases, a simple transformer being chosen in this case to make the conditions as favourable as possible to the carbon lamps. A typical house installation of 18-16 c.p. lamps and six 8-c.p. lamps, or their equivalent, is assumed, and the running hours per annum are assumed

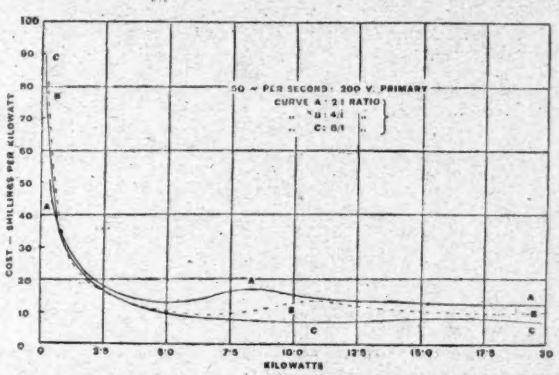


Fig. 13.

to be equivalent to one hour's burning of *every lamp* per day (*i.e.*, a total of 365 hours per lamp per year). This assumption is found to cover the case of an ordinary household very closely. The life of a carbon lamp is assumed as 1,000 hours, and of a tungsten lamp as 1,500 hours, the latter figure being, if anything, low, for there is no longer any blackening of the bulb, and the filament of

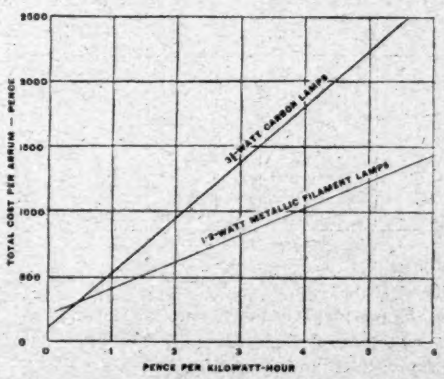


Fig. 14.

a 25-volt 16-c.p. lamp is very robust. The respective efficiencies assumed are 3·5 and 1·2 watts per candle-power, these figures being also quite authentic. The transformer is assumed to have a full load efficiency of 94·5 per cent. and the no-load current (C_L fig. 8) is assumed to flow (23 × 365) hours per annum and is calculated on a basis of a no-load loss of 6 watts—again a reliable test figure. Current is assumed at 6d., 4d., 3d., 2d., 1d. and ¾d. per B.T.U. in successive cases, and the total costs per annum in each instance are tabulated in Table II, being calculated as shown *in extenso* in Table I, where also the saving if the transformer be cut out of circuit during all but the lighting hours is shown: in the other cases the transformer is assumed to be permanently in circuit.

The results of Table II are plotted in fig. 14, and from the intersection of the two cost curves it will be seen that metallic-filament lamps, in spite of their higher cost per lamp and allowing for the use of an auto-transformer, are more economical than carbon lamps for all current rates

TABLE I.—Capital and Running Costs of Carbon and Metallic-Filament Lamps.

Carbon Lamps.

Capital costs.		*Running costs per annum.*	
24 lamps at 10s. per dozen	£1 0 0	5 % interest on capital	£0 1 0
		Renewal of lamps (8·76 at 10d. each) ...	0 7 4
		Current at 4d. per B.T.U.	7 3 1
		Total... ...	£7 11 5

Metallic-Filament Lamps.

Capital costs.		*Running costs per annum.*	
18 16-c.p., 25 volts, and six 8-c.p., 25 volts (tungsten lamps at 2s. 3d.)...	£2 14 0	5 % interest on capital	£0 4 2
		5·83 renewals	0 13 1½
		Load current	2 12 0
		"No-load" current ...	0 16 10
400-watt transformer (200/25 volts) ...	1 10 0	Total... ...	£4 6 1½
Total	£4 4 0	Saving over carbon lamps	£3 5 3½
		If transformer be cut off during day :—	
		Total = ...	3 9 3½
		Saving over carbon lamps	4 2 1½
		Saving = 43·3 per cent. in first case, and = 54·3 per cent. in second case (on carbon lamp bill).	

down to less than ½d. per B.T.U. Though the exact figures above refer only to a particular example, the latter is thoroughly representative and fully explains the growing demand for auto-transformers. That these are playing a most important part in the economic development of electric lighting and aiding in the increasing supremacy of electricity over gas as a lighting agency cannot be doubted.

TABLE II.—Total Costs of Carbon and Metallic-Filament Lamps at Various Current Rates.

Carbon lamps. Cost per annum, apart from current = 8s. 4d. (Table I). Current cost per annum	Carbon lamps. Cost per annum, apart from current = 8s. 4d. (Table I). Total cost per annum.	Electrical energy per B.T.U.	Metallic-filament lamps. Cost per annum, apart from current = 17s. 3½d. (Table I). Current cost per annum.	Metallic-filament lamps. Cost per annum, apart from current = 17s. 3½d. (Table I). Total cost per annum.
2,574d.	2,674d.	6d.	1,239d.	1,447d.
1,717d.	1,817d.	4d.	826d.	1,034d.
1,287d.	1,387d.	3d.	620d.	827d.
858d.	958d.	2d.	413d.	621d.
429d.	529d.	1d.	207d.	414d.
322d.	422d.	¾d.	155d.	363d.
107d.	207d.	¼d.	52d.	260d.

There is little improvement possible in the mechanical and electrical design and efficiency of auto-transformers, as now on the market, but much remains to be done as regards popularising their use and extending the general knowledge of their properties and merits.

Exhaust Steam Turbine Plant at Bolckow, Vaughan's.—At the annual meeting of Bolckow, Vaughan & Co., Ltd., the chairman said that in the year's capital expenditure was included the installation of exhaust steam turbo-blowing and generating plant at the steel works. During the three months that the exhaust steam plant had been running completely it had more than come up to their expectations, and if, after further trial for some months, the installation gave the same satisfactory result, they would complete the installation of their entire steel works. The Miners' Eight Hours Act was in operation in their ironstone mines; but, judging from the Home Secretary's quick promise to introduce material alterations, he thought they might assume that the miners did not find it as satisfactory in practice as they had been led to expect. At their collieries the measure came into operation on January 1st, and until the law was altered the measure must produce trouble in the Durham Collieries.

STEAM, AS AND OIL ENGINE BREAKDOWNS IN 1908.

The introduction to the annual report of the chief engineer of the British Engine, Boiler and Electrical Insurance Co., Ltd., Mr. M. Longridge, M.Inst.C.E, which has just been issued, reminds us of a truth too often forgotten—that there are two kinds of things men's eyes and minds ignore: those they have never seen, and those which are always in front of their noses. The author cites this as justification for his description of incidents old as well as new; but no excuse is really needed—not only do the inexperienced require instruction from the lessons of the past, but even those who have passed through the mill are apt to forget them and may well profit by a revision.

Noting the remarkable uniformity in the rate of increase of the number of steam engines and internal-combustion engines insured, Mr. Longridge says there is no doubt that while many small steam engines have had to give place to gas engines, the latter in turn have had to make room for electromotors; but for these, the increase in the number of internal-combustion engines would have been greater. Breakdowns of steam and gas engines take place in almost identical ratio—1 in 9·4 and 1 in 9·1—gas engines, therefore, making a slightly better showing than steam. The parts most liable to breakdown are shown in the following extracts from the tables:—

Steam Engines.

	Average for previous 24 years. Per cent.	1907. Per cent.	1908. Per cent.
Valves and valve gear	21·0	28 0	34·8
Spur gearing	14·8	10 2	8·1
Air-pump motions	10·4	10·2	5 2
Air-pump buckets and valves	7·3	4·0	6·2
Columns, bed-plates, &c.	6·9	7·7	5·2
Cylinders, valve-chests and covers ...	5·2	7·2	6·2
Pistons and their attachments... ...	3·2	5·6	5·7

Gas and Oil Engines.

Valves and valve gear	32·5	43·3	31·3
Cylinders and cylinder ends	16·6	13·5	19·4
Pistons	11·7	2·7	4·8
Connecting rods and their bolts ...	11·2	8·1	10·8
Main shafts	5·0	4·7	9·1
Fly-wheels and driving drums ...	4·3	4·7	5·4

No other item exceeded 5 per cent. of the total. The breakdowns due to old defects or deterioration amounted to 15 per cent. in the case of steam and 20 per cent. in the case of gas and oil engines; weakness, bad design, workmanship or material accounted for 31 and 18 per cent. respectively, and negligence for 25 and 27 per cent., the remainder being due to accident and causes unascertained. The author draws attention to the continually increasing percentage of steam-engine failures due to breakage of valves and valve-gear, and advocates more care in fitting. The reduction of spur-gear failures is ascribed to the rapid disappearance of such gearing from engine rooms, and the low percentage of main shaft breakages to the limitation of the unit stress to 8,000 lb. by the great makers of steam engines. The high percentage of valve-gear failures in gas engines naturally calls for comment; the cylinder breakages were largely due to severe frosts, and point again to the extreme importance of draining the jackets of standing engines. No reason can be given for the increased breakages of crank-shafts.

Amongst the examples of breakdown cited in detail by Mr. Longridge is one relating to the use of superheated steam with slide valves, wear of half an inch taking place in two months. The company's experience with slide valves working in superheated steam is "not encouraging"; Corliss valves are preferred, or, still better, for the highest temperatures, multiple-beat drop valves.

Under gas engines, the author discusses at considerable length the stresses imposed upon crank pins and shafts, and obtains formulæ for their diameters, with one and with two fly-wheels. He recommends a maximum stress of 9,000 lb. per sq. in. for shafts with two bearings, and 8,000 lb. with three bearings; the maximum explosion pressure per sq. in. is given as about 450 lb. for large, and 400 lb. for small engines, with town gas, and 50 lb. less with producer gas.

A case is cited where a gas engine was wrecked through the failure of the connecting-rod bolts, which, as so frequently happens, had no fillets between the head and the shank. When will designers learn that a sharp corner is the commencement of a crack?

Turning to electrical machinery, the chief engineer reports an increase as compared with 1907 of 11·4 per cent. in insurances, of 10·7 per cent. in breakdowns, and of 18·3 per cent. in cost of damage; the last value is evidently out of proportion, and is due to a rise of 84·8 per cent. in the cost of damage to dynamos, mainly owing to a few expensive breakdowns of large generators. Motors and controller breakdowns have increased at a lower rate than the number of insurances. The ratios of breakdown were as follows:—Generators, D.C., 1 in 13·7; A.C., 1 in 5·7; motors, D.C., 1 in 9·2; A.C., 1 in 11·3; starters and controllers, 1 in 24.

Most of the failures, as might be expected, occurred in connection with rotating parts carrying current; armatures and rotors, dynamos, 30 per cent., motors, 36 per cent.; commutators and slip

rings, dynamos 40, motors 26 per cent.; magnet coils and stators accounted for 11 per cent. (dynamos), and 16 per cent. (motors).

The bulk of the machines insured are motors, and these are further classified: armatures and rotors caused 38 per cent. (D.C.), and 21 per cent. (A.C.) of the failures; commutators and slip rings, 29 per cent. (D.C.), and 2 per cent. (A.C.); magnet or stator coils, 11 per cent. (D.C.), and 53 per cent. (A.C.). Dirt and neglect were blamed for breakdowns about equally with age and deterioration, accounting for nearly half the troubles with all classes of electrical machinery; bad work or design comes next, with 20 per cent. of the dynamo failures, 11 and 9 per cent. of the motor and controller failures respectively. One-third of the failures were due to unascertained causes. In starting switches and controllers, the resistance coils accounted for half the breakdowns, contacts and switch arms for 10 per cent., and automatic apparatus for 13 per cent., the remainder being in connection with parts not carrying current.

It is interesting to note, in the data relating to A.C. motors, that troubles with slip rings are extremely rare, while more than half the failures of A.C. motors arise in the stator coils. There is also a considerable proportion of failures in stationary parts not carrying current, such as the frames and bearings—18 per cent., as compared with 7 per cent. in the case of D.C. motors. The relative reliability of D.C. and A.C. armatures or rotors may be gauged from the figures given above—38 and 21 per cent. of the recorded failures respectively; the A.C. rotor hardly shapes so well as it is supposed to do.

Among the examples of breakdown detailed are instances of pieces of iron being drawn into the machine, where they naturally make for the region where they can do the most damage—between armature and pole-piece; a motor driving a centrifugal pump was found to be exposed to a jet of water from a hole in the pump casing; a drain cock was opened by a touch from a belt, emptying the oil well of a motor and causing the bearing to seize; the oil well of a motor in a brewery was found so full of dirt that the ring could not revolve, and the white metal in the bearing melted; a motor commutator was turned up by the owners and set to work again without cleaning the copper dust out of the mica and removing burrs—a typical case, leading at once to breakdown; a rope—one of eight—1⅜ in. in diameter, driving a dynamo by a pulley only 19 in. in diameter, broke and fouled the bearing, dragging the entire machine into the bottom of the rope race 6 ft. below. Carbon dust and oil are fruitful causes of breakdown; it is most difficult to prevent the passage of oil to the back ends of commutators, unless the latter are pressed on the shaft; when other means of fixing are employed, the old device of caulking a copper ring between the shaft and the front end of the quill is recommended. Dust generally accumulates under string binders, especially the bands that are sometimes put round the clamping rings at the ends of commutators. Another common difficulty with commutators is due to the relative motion between commutators and armatures, which is not fully prevented by the feathers, set-screws, and so on, usually employed; the core also is often not rigidly held, with the result that the conductors break off between the commutator and the armature, or the insulation is cut through by the edges of end-plates or winding drums—which, incredible as it would seem, are frequently left quite sharp instead of being well rounded off. Core plates are best held endways by a ring sprung into a groove on the shaft, as nuts are apt to slack back. Regarding brush gear, Mr. Longridge remarks that the company has had least trouble, perhaps, with brush holders consisting of a plain box holding a rectangular block of carbon, with a flexible conductor attached, and a spring to keep the carbon up to the commutator surface.

The bulk of the breakdowns are due to oil, dust and damp—especially oil, which, when it once gets out of a bearing, creeps all over, and mixing with copper or carbon dust, produces short circuits. Imperfect fitting, keying and locking of spiders and core plates, commutator bushes, &c., comes next, and careless winding and fitting of magnet coils is not uncommon. The users of electrical machinery, of course, themselves have much to answer for. The author recommends ball-bearings for motors, with regular cleaning and inspection.

Under the head of boiler insurance and inspection there are numerous examples of badly grooved and corroded boilers offered for insurance—but not accepted. One curious instance is cited where the flanges of a number of mild steel steam pipes were found to be most imperfectly welded—hardly attached at all, in fact; they had, however, been at work for five years before one of them gave way. Of the land boiler explosions reported in 1908, eight in number, none were in electrical works; there were seven fatalities, due to these, as well as 14 others due to collapses of fireboxes and flues and sundry mishaps on land. Only two deaths took place in connection with boilers insured.

In conclusion, Mr. Longridge draws attention to a fault in the design of vertical air-pumps applied to factory engines, the condenser being water-sealed, in a case observed by the author, with an effective head of no less than 50 in., with the result that a satisfactory vacuum could not be obtained. The author suggests modifications in the design which would avoid the trouble, dispensing with a foot-valve and greatly improving the vacuum obtainable.

Fatality.—While Leonard F. G. Cone, aged 19, an electrical engineer of Plumstead, was in camp at Salisbury he was struck on the nose by his horse's nosebag, and on his return home he died in Woolwich Infirmary from meningitis. Verdict, "Death from misadventure."

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

GERMANY (*continued*).

	Marks per 100 kg.
Steam boilers of wrought-iron, also assembled parts of the same, provided with fittings or not	5
Boilers with more than 10 similar tubes of a diameter amounting to 300 mm. or less, clear; and boilers of all kinds of non-malleable cast-iron, weighing 5,000 kg. or less per piece	8
Ditto, weighing more than 5,000 kg. per piece	6
Articles of coarse lead	6
Copper rods, sheets, plates &c.	12
Copper wire, iron wire with wire of copper or copper alloy wound round it or plated or twisted thereon	12
Copper wire rope and cable, neither lacquered, polished nor nickelled	15
Coarse wares of copper and of cast brass, not otherwise mentioned; tubes and pipes	18
Wares, other than coarse wares, of copper or cast brass; lacquered or polished; sheet-copper and sheet-brass	30
Copper, tombac, and brass wires, *verniert*, coloured, or nickelled, not being "ornamental wares"	60
Wares of copper alloys other than tombac or brass, not being "ornamental wares":—	
Fine, especially all polished, nickelled, coloured, lacquered, or *verniert* wares	60
Other than fine, neither polished, nickelled, coloured, lacquered, nor *verniert*; metal foil	30
Steam engines, steam turbines, water-power machinery (turbines, water-wheels, water-pressure engines), combustion or explosion motors, combined or not with dynamos:—	
More than 500 up to 1,000 kg.	11
More than 1,000 up to 2,500 kg.	7·50
More than 2,500 up to 5,000 kg.	6
More than 5,000 up to 50,000 kg.	5
More than 50,000 up to 100,000 kg.	4·50
Dynamos, electromotors, continuous-current transformers, also finished armatures and commutators; converters and reactance coils, weighing:—	
500 kg. or less	9
Over 500 and up to 3,000 kg.	6
Over 3,000 and up to 10,000 kg.	5
Over 10,000 kg.	4
Machines firmly attached to dynamo-generators or motors, dutiable as machinery.	
Accumulators and electrodes therefor:—	
Combined with celluloid, vulcanite, &c.	24
Other	6
Underground electric cables encased in a protective cover of metal sheet, wire or the like	8
Telegraph appliances, telephones, electrical appliances for surgical and dental purposes, galvanic and dry batteries and thermo-electric couples	60
Electric appliances for illumination, transmission of power, or electrolysis; electric measuring, counting and registering apparatus; resistances and shunts; other electrical appliances not specially mentioned, and component parts of such articles, weighing:—	
10 kg. or less...	40
More than 10 kg. and up to 25 kg.	30
More than 25 kg. and up to 100 kg.	20
More than 100 kg. and up to 500 kg.	8
More than 500 kg. and up to 1,000 kg.	6
More than 1,000 kg....	4

(*To be continued.*)

A Hint to Electrical Undertakers.—The American *Electrical Record* quotes an unusual use to which electricity is being put in a New York church:—"As a means of raising money to pay off a debt this church uses electric lights as memorials to the dead after the following manner:—A huge altar electrolier includes name-plates as part of its winding vine decoration, about each of which is a cluster of 10 incandescent lamps. Subscribers desiring the prayers of the congregation for their dead pay $1,000 for each light. The name of the deceased is then inscribed on the plate above the cluster of lights, and one light is lit, to be kept burning at all services. The payment of each successive $1,000 means the lighting of another light, the maximum amount being $10,000 for each name. Eighteen of the name-plates have already been subscribed for and 30 lights purchased. The memorial is so constructed that it can be lengthened and enlarged almost endlessly, and the pastor of the church is reported to be looking forward to the day when it will reach the high vaulted ceiling and start twining its way along the sides of the chancel." This suggests a field of wonderful possibilities!

NEW PATENTS APPLIED FOR, 1909.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

19,329. "Appliance whereby the blind can detect and trace pencil writing by means of an electrically rung bell or gong." A. M. Cox. August 23rd.

19,359. "Improvements in and relating to electric safety lamps for use in mines or other like places." J. G. Patterson. August 23rd.

19,387. "Improvements in arc lamps." S. C. Mount and Beck Flame Lamp Co., Ltd. August 23rd.

19,392. "Improvements in or relating to dynamo-electric machines." B. G. Lamme. (Date applied for under Sec. 91 of the Act, October 7th, 1908, being date of application in United States.) August 23rd. (Complete.)

19,393. "Improvements in or relating to dynamo-electric machines." F. W. Le Tall. (Westinghouse Electric and Manufacturing Co., United States.) August 23rd. (Complete.)

19,394. "Improvements relating to dynamo-electric machines." F. R. Kunkel. (Date applied for under Sec. 91 of the Act, September 8th, 1908, being date of application in United States.) August 23rd. (Complete.)

19,397. "Improvements in submarine cable telegraphy." W. Judd. August 24th.

19,424. "Improvements in electric lighting devices for life-buoys." J. F. Trentmann. August 24th. (Complete.)

19,434. "Improvements in electrical detectors or contact-makers for use in connection with railway switch points and the like." E. C. Irving. August 24th.

19,465. "Device for varying the intensity of light of electric lamps." A. de Stefano. (Date applied for under Sec. 91 of the Act, August 26th, 1908, being date of application in Italy.) August 24th. (Complete.)

19,466. "Improvement in electric furnaces for the treatment of gases by means of flame arcs." Salpetersaure Industrie-Gesellschaft G.m.b.H. (Date applied for under Sec. 91 of the Act, August 25th, 1908, being date of application in Germany.) August 24th. (Complete.)

19,475. "Improvements relating to magneto-electric machines to be used for medical purposes." T. Morris. August 25th.

19,496. "Improvements in or relating to driving mechanism for use with electric motors." W. G. Mambridge. August 25th.

19,516. "Process and apparatus for electro-mechanical transmission to a distance of half-tone illustrations, portrait and other photographs, engravings, manuscripts, typograms, and the like." H. Carbonelle. (Application for Patent of Addition to No. 5,187, 1907.) August 25th.

19,527. "Improvements in or relating to the transmission of power by means of magnetisable pulleys, bands, and the like." A. Huguenin. (Date applied for under Sec. 91 of the Act, August 25th, 1908, being date of application in Germany.) August 25th. (Complete.)

19,565. "Improvements in or relating to electro-magnetic switches." W. H. Powell. August 26th.

19,599. "Improvements in or relating to means for cooling the rotor-windings of dynamo-electrical machinery." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G m.b.H., Germany.) August 26th. (Complete.)

19,600. "Improvements in methods of charging and discharging electric accumulators or secondary batteries." A. M. Taylor. August 26th.

19,603. "Improvements in apparatus for electric telegraphs." Siemens Bros. & Co., Ltd., and G. S. Grimston. August 26th. (Complete.)

19,615. "Improvements in alternating-current motors." A. H. Midgley and C. A. Vandervell. August 26th.

19,637. "Improvements in and relating to starting switches for electric motors." A. D. Smith. August 27th.

19,660. "New or improved coin-freed apparatus for supplying or measuring a current of electricity." J. A. Farrand. August 27th. (Complete.)

19,662. "Improvements in spring switches for electrically setting railway points and signals." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) August 27th. (Complete.)

19,684. "Improvements in electric signalling apparatus." Siemens Bros. and Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) August 27th. (Complete.)

19,718. "Improvements in shades for electric glow lamps." G. Davis and H. J. Simpson. August 28th.

19,719. "Improvements in casings and coverings for electric circuits." E. W. Lancaster. August 28th.

19,732. "Improved tumbler switch for electrical currents." A. E. Watkins. August 28th.

19,747. "Electric safety switch." W. J. Brooks. August 28th.

19,757. "Varicolour reflecting air-worked arc-light advertising sign." F. J. Torode. August 28th.

19,758. "Improved construction of electric arc lamp." C. Parsons and W. G. Hunt. August 28th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Electrical Control of Mechanism from a Distance. G. C. Lohay. 14,396. July 7th. (Date applied for under International Convention, July 16th, 1907.)

Control of Mechanism from a Distance. G. C. Lohay. 14,420. July 8th. (Date applied for under International Convention, September 26th, 1907. Application for Patent of Addition to No. 14,396/08.)

Electric Galvanic Batteries. G. Schauli. 14,609. July 9th.

Electrically Blocking a Single-Line Railway. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 14,784. July 11th.

Method of and Apparatus for Compounding Alternating-Current Generators. M. Breslauer. 14,897. July 14th. (Date applied for under International Convention, July 15th, 1907.)

Electrical Typewriter operating Attachment for Message Transmission. G. A. Mayrand. 16,791. August 10th.

Electric or like Conduit Jointing. T. G. Hann. 16,863. August 11th.

Control of Dynamo-Electric Machines. British Thomson-Houston Co. and F. W. Carter. 16,997. August 12th.

Electric Ignition Devices. A. S. Postans. 17,159. August 14th.

Magnetic Brakes for Tramway and other Vehicles. R. Shears. 17,211. August 15th.

Protective Devices for Electrical Installations. British Thomson-Houston Co. and E. B. Wedmore. 17,899.

Starting Switches for Electric Motors. G. H. Garside. 18,965. September 10th.

Protective Devices for Alternating Electric Current Systems. British Thomson-Houston Co. and E. B. Wedmore. 20,498. September 29th.

Trolley Poles for Trams and like Electrically-driven Vehicles. S. Bryan. 20,575. September 30th.

Depolarisers for Electric Batteries. G. Schauli. 24,355. November 12th. (Date applied for under Rule 13, July 9th, 1908.)

Depolariser for Electric Batteries. G. Schauli. 24,356. November 12th. (Date applied for under Rule 13, July 9th, 1908.)

Automatic Switching or Controlling Apparatus for the Distribution of Electricity. E. G. Bryant and R. A. Pearson. 25,134. November 23rd.

1909.

Apparatus for Controlling Electric Motors. H. E. Dey. 759. January 12th.

Control of the Current and Voltage in Dynamo-Electric Machines. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke-Ges.) 1,509. January 21st.

Regarding Mechanism for Electric-Motor Starting Switches, Valves, and like Apparatus. Siemens Bros. Dynamo Works and B. G. Payne. 4,817. February 22nd.

Automatic Regulators for Electric Circuits. British Thomson-Houston Co. (General Electric Co.) 4,882. February 27th. (Application for Patent of Addition to No. 5,037/07.)

Alternating Electric-Current Machines. R. Moser. 6,103. March 13th (Date applied for under International Convention, March 14th, 1908.)

Electric Wire Supports. C. C. Gould. 7,610. March 30th.

Arrangement of Thermo-Piles. B. von Wysocki. 11,230. May 12th.

Electrical Fatality.—On the 1st inst. an inquest was held at Ramsbottom, Lancs., by Mr. Barlow, Deputy Coroner, on the body of John W. Garner, 5, Hulme Terrace, Ainsworth, who met his death at the electric sub-station of Messrs. Turnbull and Stockdale's works, Stubbins. Mr. R. C. Leslie and Mr. C. D. Taite represented the Lancs. Electric Power Co. It was stated that the deceased was an electrician's labourer in the employ of the Lancs. Electric Power Co., and that he had followed the occupation for three years. Dr. R. Crompton said he found the deceased lying on the ground outside the sub-station door, which is entered from the bleach works yard. He had since made a post-mortem examination, and found that there was a small wound on the bottom of the right hand between the roots of the middle and ring fingers. This was burned around and was sufficiently large to admit the point of a pencil. It was ⅛ in. deep. There were also blisters at the roots of the fingers, and the skin was scarred at the back of the hand, the wrist and arm scorched to the elbow and the hair burned off. The left hand was scorched to the elbow, and the face was discoloured on the left side, and the moustache singed. On the right side between the shoulder blade and the spine was a scorched puncture of flesh corresponding with the holes in the garments, and in his opinion death was due to electrical shock as a result of the current striking the right hand of the deceased. David Ferguson, an assistant erector, said the deceased was a careful man. Witness was engaged erecting a transformer on the wall of the sub-station. Deceased had just gone out of the door, and there was a flash and report, and he then found deceased lying in front of the transformer. He was bleeding from the mouth. He thought deceased must have stumbled on to the live contacts. The switches were 6 ft. 4 in. from the ground, and there was a temporary platform 2 ft. 10 in. high. Mr. Taite said they were under the impression that the deceased attempted to climb the platform, and stumbled and put out his hands to save himself. The voltage that came into the sub-station was 10,000. They were instructed that the charged metal on the top of the yellow board was dangerous. There was no screen, and there were no rubber gloves or boots provided, though there was a rubber mat under the switchboard. J. Millar, electrical erector in charge of the job, said that deceased had instructions to enter the station only on the low-tension side of the transformer. He did not think it necessary to have a screen in front of the switchboard, and there would have been great danger to anyone putting such a screen up. He had individually cautioned the deceased. The jury returned a verdict that the deceased accidentally came to his death by electric shock, and sympathy was expressed with the deceased's relatives.

Rubber Coagulant.—It is reported that Mr. O. A. Elias, F.C.S., has discovered a chemical reagent which effectually and quickly coagulates rubber latex, without injury to the resulting product; coagulation has always been one of the most troublesome and difficult processes in the preparation of raw rubber, and the new method, if found satisfactory, will be heartily welcomed by rubber collectors and manufacturers.

British Association.—The *Times* Winnipeg correspondent reports that nearly 200 members of the British Association left Winnipeg on the evening of the 2nd inst. for a western trip over the Canadian Pacific Railway. They will be back in Winnipeg on 13th inst. ready for the return home.